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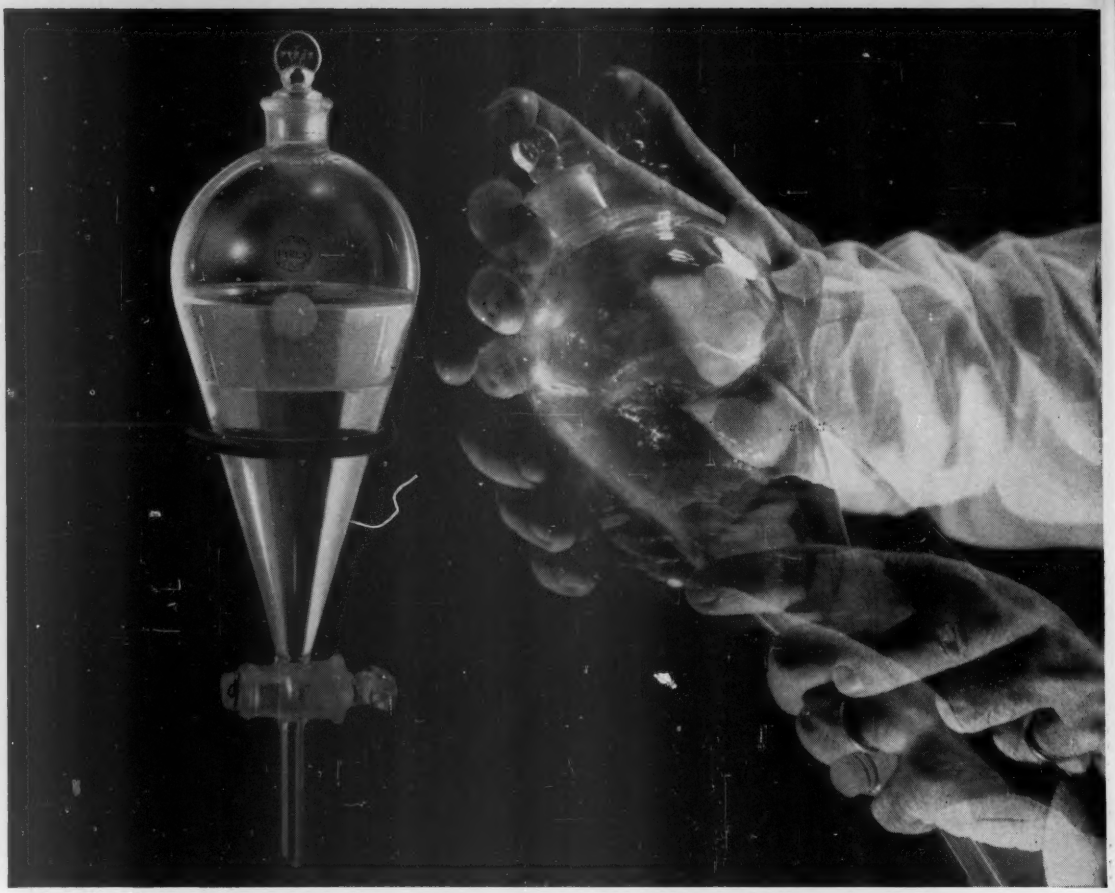

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Swords into Plowshares

The ratification of the Statute of the International Atomic Energy Agency by the U.S. Senate on 18 June brought to nine the number of nations that have formally approved the document. This action makes it virtually certain that a large enough number of nations will follow suit to ensure the establishment of the agency and its organization at the general conference in Vienna next October.

The International Atomic Energy Agency is an outgrowth of President Eisenhower's bold "atoms-for-peace" proposal to the United Nations on 8 December 1953. After months of preliminary negotiations, 12 states unanimously agreed on a statute for the agency on 18 April 1956; this was approved by 81 states on 26 October 1956 and signed by 80 states during the following three months when the instrument was open for signatures. What still remained to be accomplished—and this was a large order—was to have the statute ratified. Until quite recently, there was some doubt about approval by the Senate during the present session of Congress. Hearings before the Senate Foreign Relations Committee and the Senate members of the Joint Committee on Atomic Energy did much to make clear the usefulness of the agency and to give assurance that proper safeguards against diversion of materials for use in weapons were provided for. Another stumbling block was the fear on the part of some senators that the agency might sometime commit the United States to a course of action without Senate approval. Had this reservation taken the form of a modification of the treaty, lengthy renegotiation would have been required and the agency might have been stalled for months or years or indeed stifled at birth.

The Foreign Relations Committee, however, worked out a compromise in the form of an understanding with the Administration that any amendment to the statute should be submitted to the Senate and that the United States would withdraw from the agency if an amendment unacceptable to the Senate were adopted. Inasmuch as the statute itself already gives members this privilege (". . . whenever a member is unwilling to accept an amendment to this Statute, it may withdraw from the Agency by notice in writing . . ."), the action of the Senate seems to serve merely to underline the privilege, allay anxiety, and put the Executive on notice about Senate prerogatives.

The principal aims of the agency are to increase the contribution of atomic energy to "peace, health, and prosperity throughout the world"; to promote research on the development and application of atomic energy; to facilitate the exchange of information and of scientific and technical experts; and to set up standards for the protection of health in the field of atomic energy, both in the agency's own operations and in those that it facilitates.

Of the numerous safeguards to prevent diversion of materials for military use, one is the right of the agency to send inspectors into states that receive its aid. Thus, the agency will give participating nations experience not only in cooperating in the field of atomic energy, but also in tolerating the kind of inspection and control that must precede any reduction in the threat posed by atoms-for-war. G. DuS.

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Soviet and U.S. Professional and Technical Manpower

M. H. Trytten

It is particularly fitting, I believe, that at this time we look back at the profound perceptions expressed in the philosophies of Francis Bacon, while at the same time we consider the meaning for us of the educational developments in an alien but challenging society such as that of the U.S.S.R.

Bacon asserted that it had not yet, in his time, been recognized that the true aim of all science is "to endow the condition and life of man with new powers or works" (*1*) or "to extend more widely the limits of the power and greatness of man" (*2*, p. 116). Bacon, however, does not take the position that these are the sole purposes of research. Truth for the sake of truth is by no means excluded. Indeed, by pursuing truth for the sake of the power with which it endows mankind, one also arrives at true knowledge, since without knowledge there is no power. Whether one seeks truth first and utility second, or vice versa, are, in fact, the same, since "works themselves are of greater value as pledges of truth than as contributing to the comforts of life" (*2*, p. 124). Bacon must be credited with emphasizing the fact that knowledge should proceed in the consciousness that the growth of knowledge is the way to increased power over man's environment. The Soviet perversion of this philosophy is that power, and power alone, is the justification for both education and the pursuit of science. It is a dangerous perversion, because it is true that knowledge is power. The danger lies in the fact that, in the U.S.S.R., the search for knowledge by the state is greatly supported for power purposes alone. Education there is the instrumentality for the pursuit of science.

Dr. Trytten is director of the Office of Scientific Personnel, National Research Council, Washington, D.C. This article is based on an address presented at a symposium on "Science and invention in the service of the state" at the 65th anniversary convocation of Drexel Institute of Technology, Philadelphia, Pa., 2–4 Dec. 1956.

Soviets and the Baconian Concepts

The Soviets have thus stepped well beyond the position of Bacon and have added to his concepts the additional factor of a science and an educational system directed to the support of a superpowered state.

The first shock of this information has, to some extent, worn away. This does not mean that the significance of the developments in Soviet education has been discounted, or that the validity of the information has been questioned. It has, however, been possible to take a more mature look at the program of the U.S.S.R. in education and to examine somewhat more dispassionately its meaning for us and for the world. While the evidence from the U.S.S.R. has been clearly pointed to the need to examine critically our own system of education, it is becoming possible to reevaluate our own program primarily in the light of our own needs and desires, our own resources and capabilities, our own social institutions, and our own educational philosophy rather than under the effects of a sort of hysteria which appeared to exist for a time in the minds of some.

Although this is a boon and an advance, it should by no means blind us to the significance of those aspects of the Soviet system which differentiate it so sharply from its own past, from the traditional systems of Europe, and from ours, and which do lend it significance in the context of a world in fundamental conflict.

Purpose of Soviet Education

The characteristic of Soviet education which stands out above all others is that it is conceived, consciously and totally, as an instrumentality of the state. This is indeed something new under the sun, except that the possibility of this rather stark and barefaced policy is certainly inherent in Bacon's philosophy, although he, I am sure, would have been horrified at such a distortion of his ideas. Certainly, never before has the relationship between the training required by a modern industrial state and the economic, political, and military power aspired to by that state been so clearly envisioned. Never before has it been so clearly stated or so clearly enunciated as national policy. The implementation of that policy has been consistently energetic, and the continued support by the state, manifest.

The effect of this great interest by the state is apparent in a number of respects. Even as far down in the system as the early grades, the curriculum reflects a heavy emphasis on the technical branches. This emphasis is actually increasing. A statement made recently in Hamburg, Germany, by A. Shibanov, chief of polytechnic instruction of the Academy of Pedagogic Sciences of the U.S.S.R., describes the plan of the Soviet State for increasing this emphasis. By 1960, he stated, secondary-school instruction up to age 17 would be obligatory. Science and mathematics and "scientific foundations of production" will then account for 55 percent of the curriculum up to the end of secondary instruction, he said. The percentage is now about 40 percent in the first 10 years of Soviet schools.

Already, in 1956, about 90 percent of those who finish the first seven grades go on either to secondary school or to one of the many *tekhnikums*, which provide a substantial degree of technical or semiprofessional training. This is an increase from about 70 percent 3 years ago. These *tekhnikums* are themselves an important indication of the practical slant of Soviet education. Training in them is intended

to provide numbers of persons well qualified to assist the fully trained professional specialist in the many fields for which the higher educational institutions provide personnel. In the fall of 1956, 480,000 persons were admitted to the entrance year of these institutions.

In the fall of 1956 there were enrolled about 1.2 million full-time students in higher educational institutions and about 700,000 additional extension students; and in the *tekhnikums,* about 1.6 million regular students and about 300,000 extension students. This adds up to a total of almost 3 million past-secondary-school students.

Qualitative Considerations

Sheer numbers, however, do not adequately reflect the nature or the intensity of the Soviet effort. In any human enterprise in which many are engaged, the intensity of the effort is dependent only partially on numbers. More important than numbers is the quality of the participants, their motivation, the competitive drive which powers them, and the satisfactions which can come to them as a result of their effort.

It is attention to these aspects which sets the Soviet program aside as something new. In other lands these factors have largely been determined as the outcome of the evaluation of social and educational attitudes among the people of these countries. They have never been consciously manipulated by central authority. In the U.S.S.R. these matters have been quite consciously contrived.

Rewards for persons who are productive in the fields of science and technology are relatively among the best available in that social and economic structure. Salaries are relatively high. Scientists and engineers are glorified in the press and over the radio as distinguished "servants of the people." They enjoy a relatively large measure of freedom, perhaps primarily because their work scarcely involves controversial philosophic concepts, but nevertheless they are freer to pursue their activities unmolested. Those who are successful teachers enjoy even more prestige and advantage. It is indeed strange to read complaints in the Soviet press that teachers earn more than industrial scientists. It is also strange to read of competition among grade-school and high-school youth in mathematics and physics, with honors and acclaim redounding to the winners, much as we recognize our football heroes.

This manipulated atmosphere of obeisance to accomplishment in intellectual matters is, in large measure, responsible for the intensity of the Soviet educational effort. The other factor in creating a highly competitive situation in the schools is the system of successive screenings which occurs at the various levels of Soviet education. Indeed, many are called but few are chosen may be the pattern, at least in the higher reaches of their system.

The progressive thinning out of the flow of students through the schools is perhaps, to some degree, due to economic circumstances, but this is not the major factor. All tuition fees, from elementary school through the university, are abolished. As of October 1956, grants-in-aid are available, not only on the basis of scholarship, but also on the basis of need.

Article 121 of the constitution of the U.S.S.R. has recently been revised by the Supreme Soviet to read: "All citizens of the U.S.S.R. have the right to education. This right is insured by universal compulsory seven-year schooling, by extensive developments of secondary education, by the fact that all forms of education, both secondary and higher, are free of charge, by a system of state stipends for students who have distinguished themselves in higher schools. . . ."

The process of successive culling results in the fact that about a quarter of those who enter the first grade emerge as graduates from the tenth grade, the remainder veering off to enter labor schools, schools for skilled or semiskilled, and higher technical schools such as *tekhnikums,* or to enter employment. The major selection, however, is made at the university level, where rigid entrance criteria are exercised. In the 1956 academic year, selections for the first year of university work were actually reduced over 1955. In October 1956 only 223,000 regular students were admitted, as compared with 285,000 a year before. The drop is rather clearly due to heightened selection standards.

The net result of this complex system of conspicuous rewards and unsentimental rigidity in screening at various levels is to contribute to a high degree of competitive intensity of effort through the length and breadth of the educational system. I am reminded of an incident related by an American who found himself working with a Russian in a recent international scientific conference. He told how the Russian had found it necessary to return to his home while his daughter underwent her entrance examinations for the university—not to help her, which he could not do, but to give her moral support during a very critical period of her life.

Incentives to Education in Science

Perhaps to these characteristics should be added the various special features which tend to make the basic scientific categories, such as physics, mathematics, and engineering, the more attractive fields, with the result that the abler part of the flow of students is polarized toward these disciplines. This is achieved by military service exemptions for persons in these preferred categories, by differential rewards, and by the relative absence of political interference.

Finally, it is worth stressing that one of the motivations behind the state interest in specialized education, aside from the clear conception of the role that technology plays internally in the development of industrial and military might, is the usefulness of technology as a political weapon of conquest in the uncommitted nations. Especially in very recent years the growing emphasis on export of specialists for political reasons is apparent. Offers of technical assistance to many nations have been a common item of international news.

While the American reaction to the outlines of the Soviet educational effort has matured over the past few months, and while it is generally recognized that there should be no desire on our part either to emulate the Soviet program in any respect or, indeed, to attempt to match it point by point, it would be unwarranted to deny that it does present a challenge. It does call for some reevaluation of our own educational program to determine whether, in fact, our system does meet our own needs in a tumultuous world in which the role of the product of specialized training is becoming ever more crucial.

New Role for Science and Invention

Surely if Bacon were alive today he would find it necessary to extend his thinking to apply it to the modern world, particularly the Western world in its present position vis-à-vis the new, belligerent civilization which confronts it. To the goal of knowledge for the sake of power over nature and the environment, which he envisioned, one must now add that science and education, in the service of the community, must take also a large share of responsibility for the defense of the Western world. They must also provide the leaven for the expansion of the economies of our nation.

The prescience of one great intellect perceived, as long as three centuries ago, that the role of science and invention and of technologic education must be not only to search for truth but also to direct the fruits of science in the interests of the community and mankind. It could hardly have envisioned the extent to which these elements are now the major pillars of our social, economic, military, and other activities. As one contemplates the services of modern technology in the

interests of the community and the state, the catalog is indeed a long and a growing one. But not only is it already an extensive catalog; it is destined, as surely as one may predict anything in a changing world, to be greater and even greater.

One can now, from the vantage point of the mid-20th century, look back upon that era of 100 years ago to appreciate the enormous changes that have occurred. It is since that time that our great technologic civilization has taken form. It is since that time that perhaps 98 percent of what we call modern technology has been established. It is in that short century that essentially all of the industries that are now our colossi have come into being, such as those in chemicals, pharmaceuticals, petroleum, communications, transportation, and the like.

In each case the services which these industries render have been built into the warp and woof of our existence so that they represent not only the luxuries and comforts of our lives but the very basis of present-day life, community organization, economic support, and economic and military security. Consequently, the services to the community, and that state which Bacon envisaged, now go far beyond anything he foresaw. Technology must ever meet the needs of this voracious demand of our day for technologic services. It must press on to achieve new levels of accomplishment in harnessing the phenomena of nature to our purpose. And our technical institutes must furnish the ever-increasing flow of personnel of advanced training needed to carry out these increasing functions of technology. Such institutes are going to be particularly preoccupied with the problem of meeting, on the one side, the requirements of a growing surge of youth into the halls of learning and, even more importantly, with helping to meet the insistent cry for more and better graduates from the technologic branches.

Manpower Requirements in the U.S.

Within the recent past, newspapers have carried the earnest plea of such persons as Admiral Rickover, of the Navy's atomic submarine effort, and of Lawrence Hafstad, of General Motors Company, for greatly accelerated training of specialists in the technical branches. Rickover proposes drastic revisions of our school systems to meet our coming needs. Hafstad calls attention to the recent official estimate of the Atomic Energy Commission that, in the next few years, nuclear research and engineering alone will need another 40,000 scientists and engineers.

The growth of employment in the United States has been a plainly overt phenomenon with its own remarkable acceleration. Within this employment total the trend has been toward the technologic industries. But within the technologic industries, again, the trend has been toward ever-increasing percentages of persons with ever higher training.

The rate of this increase in the demand for personnel with advanced training has been a very difficult thing to measure in our society, and, in fact, even the methodology of such study is not available—tried, tested, and reliable. But evidences are by no means absent, nevertheless, of the growth of our personnel demands.

One has only to note the growth of the engineering profession over the past two decades to appreciate what has happened. The 700,000 engineers, more or less (which now is about our supply), are not only the products of our university and technical institute courses but also represent a substantial effort on the part of employers to upgrade any available talent by on-the-job training and other intensive efforts. And yet the demands outstrip the supply.

Specific industries have reviewed their histories and have examined their historic trends with the thought of projecting into the future the firm trends of the past. The evidence, they have decided, leads to predicted levels of activity which would have seemed quite unbelievable a quarter-century ago but which, today, are actually unfolding at indicated rates.

The recent road programs of the Federal Government, the recently announced multi-billion-dollar expansion program of the communications industry, huge research laboratories recently dedicated, all present their evidences that our technology is expanding at a rate as great as during the past half-century, that it is becoming substantially more technologic and, hence, accelerated in its demands for highly trained personnel, and that the extent of training for the personnel required is constantly rising. The prediction seems eminently justified that our schools are unlikely to be able to satisfy the accelerating demand, insofar as one can foresee the future, even though one takes into account the increasing number of youths entering the college age group during the next decade. Our industry has more than doubled its demands every decade. In spite of the formidable increases in enrollment due in another decade, the increase in number of youths of college age causing that increase is not so large as to double present levels.

Educational Challenge

Thus, as one contemplates the rapidly increasing role of technology in the services of the state and of the community, the challenge to our system of education, both from without our country, in the light of other systems of education, and from within, in the light of our own needs, is a grave and serious one.

I have been speaking primarily of technologic personnel. It would be out of balance, however, to fail to point out that the same increases in demands which occur in the technologic fields also occur in a large part of other disciplines. Public administration, economics, psychology, and many other fields show the same surge forward of demand because of the same increase in complexity in our society. Problems of organization, of personal human relationships, service functions, and a host of other problem areas all show accelerating demands. It is important to bear this in mind, for we unconsciously tend to serve only one, not all, of our needs, and it is clear that we cannot expect to solve our manpower problems in one area at the expense of another. Education has moved into the position of a major factor in our economic well-being, a major bulwark in our national defense, and a key factor in our friendly relations abroad. As its importance is more fully recognized, its proper functioning becomes more significant.

I do not intend, here, to undertake any exhaustive reevaluation of our educational system, nor am I competent to do so. However, I think a few comments may be in order, stemming from the foregoing considerations.

Perhaps one of the major questions which we should ask ourselves is the extent to which the needs of the state and the community shall be a conscious factor in the development of our educational system and in the channeling of our youth into the various specialized areas of instruction. The very thought of this strikes us as alien. Our educational system has, from the beginning, been heavily influenced by our emphasis on the dignity and freedom of the individual. Thus, we have emphasized opportunity, but in terms of the opportunity of the individual to reach his own self-determined goals, with the happy confidence that, if each person develops himself according to his own desires, the sum total of all these desires and of all these developments will be a population whose capabilities add up to the best possible sum.

There are increasingly many who are beginning to question whether we should not reevaluate this position entirely. I am sure that no one would ever wish to see a situation arise in our country where people were told what to study, or would even want to have them subjected to heavy influences that would tend to channel personnel into areas of specialization according to some master plan. Our pas-

sion for self-determination and for freedom of thought and action will always be too great for that. However, to state that we who are charged with educational responsibilities do not also have responsibilities for the extent to which the products of the educational system of our country serve its greatest needs is an untenable position. The end-result of the educational system in its product, at all levels, is by no means solely determined by the individual choices of the students at the various levels. These choices themselves depend on a wide variety of circumstances and policies which are laid down as a guide and, in many cases, as a completely limiting factor in the exercise of choice by the individual students. The very latitude of choice which remains is a matter of policy which is determined in one way or another at each level in the educational system.

Role of Secondary Schools

One of these policy questions which, in the opinion of many, is in grave need of review is the purpose and role of our own secondary school. The growth of this great institution in the past four decades has been a monumental fact in the development of American life. It has served a great social purpose in creating a more homogeneous and literate public. It has also, however, by the sheer magnitude of its task, been driven into certain patterns which warrant scrutiny.

In most high schools a majority of the students have been terminal students, as distinct from those intending to go on to higher education. This has led to a preoccupation with these terminal students, and with their needs, that has often tended to ignore the more able students and those who should be building toward advanced training. Sometimes this has occurred because a school simply has not been able to serve both groups adequately with its limited resources. Sometimes it has happened because of the attitudes and interests of its faculty. Sometimes it has happened because of a doubtful philosophy of secondary education—that democracy requires that all people be cast in the same mold. The result has been a very real question whether our high schools are not of doubtful efficiency for the better students.

It has been of much interest in this connection to observe the results of an experiment by the Fund for the Advancement of Education. A few years ago they entered into relationships with a number of higher education institutions whereby second-year high-school students, carefully selected, were admitted to college on a par with high-school graduates. After a few years it has now been possible to evaluate progress of these young people in comparison with that of their classmates of matched intellectual ability. These students, on an average 2 years younger than their fellows and presumably handicapped by having had only 2 years of high school, out-performed their classmates. Their grades were definitely higher. If this is a fair experiment, it seems to indicate at least a doubtful contribution by the high schools in their last 2 years.

I am convinced that if we are going to solve our educational problems of the kind earlier discussed in this article, it can be done only by regaining lost ground in the secondary schools. There is no inherent reason why American secondary-school students cannot perform at least as well as students of comparable age abroad. It is no uncommon experience in Europe, for example, to find a youth of 13 or 14 who has a good grasp of one or two foreign languages and of mathematics, through the calculus, and who has made substantial progress in the sciences, history, and literature. And yet a statement such as this is met in our country with incredulity. Certainly American youth can meet these challenges as well as those of any other country, and enjoy the doing of it, if our schools can, in fact, be geared to challenge the full ability of each student in a program worthy of his intelligence.

Need for a Balanced Curriculum

It should perhaps be emphasized that this is by no means a plea for more science and mathematics at the expense of a well-rounded curriculum. It is much more appropriate that a student round out his education at the high-school level than at the college level, where the inexorable demands of specialization are beginning to preempt time and capture interest. It is a plea for a curriculum and for standards at the secondary-school level which are worthy of the caliber of the young people who later must be our leaders in the professions and in all of the many specialties which our society demands. There is no unkindness we can do our youth or our society greater than to establish the thought that the above-average youth should be content with an average accomplishment.

It is my conviction that in the strengthening of the secondary-school curriculum lies our only hope of meeting the numerical demands of the future for specialists. If a well-rounded curriculum is available for the student, with substantial mathematical and scientific courses, as well as other disciplines, and if these courses are taught so as to give him a feeling of accomplishment, of competence, and of interest, he is more than likely to follow his interest into advanced work. The greatest deterrents to the pursuit of advanced training in any of the intellectual disciplines are shaky and inadequate preparation, weak motivation, lack of aroused intellectual interest, and slovenly mental habits.

Role of Higher Education

What, then, of higher education in the sciences and engineering? Should more persons enter these fields of study to meet the growing shortages which have arisen to plague us? The answer to this question might appear obvious, and yet many thoughtful persons have seriously questioned whether added emphasis on science and technology at the college level and added efforts to channel more students into these fields may not tend toward a mechanistic society and away from ancient traditions and values. This is a question none of us would wish to treat lightly, I am sure.

Nevertheless, the question, it seems to me, lacks realism. The rate of increase of our requirements for personnel of advanced training has been a phenomenon growing directly out of the complex of social and economic trends that form the fabric of our civilization today. The health and the strength, the vigor and the growth, of our economy rest on satisfying the ever-growing demand for people of special skills and knowledge. To remain a vigorous and vibrant civilization, we must have the annual influx of young, well-trained minds. This is a necessity and not merely a philosophic desideratum. If the lessons of the past can at all be extrapolated into the future, they seem to me to indicate that the extent to which we can increase our supply of persons in the special areas of science and engineering will determine our future well-being and strength.

One of the fallacies in the arguments of those who question the wisdom of increasing the numbers of persons trained in the sciences is the thought that scientists and engineers are necessarily narrow in their training and unaware of their political, economic, and intellectual environment. I would agree at once that a curriculum in the sciences can be too narrow. There are those who graduate with a limited background of general information and no interest in widening their horizon. But this is equally true in other fields, such as economics, education, linguistics, or political science. Narrow specialization carries the same penalties, both for the individual and for society, whether it be in the one field or another. The answer to the question of whether our nation does or does not become more materialistic lies not so much in the professional training of our specialists or in the numbers of persons in

one field or another as it does in the integrity and character of the rest of the curriculum, if indeed the school system as a whole is the determining factor in these matters. We tend to forget, sometimes, that perhaps the most important factors in shaping our attitudes and our ways of thinking are the homes, the churches, and the mass media of communication.

Time for Reevaluation

While these things, I believe, are true, they do not minimize the importance of a reexamination of all our curricula. We need more persons trained in the technologic specialties, but not at the expense of other areas of training necessary to our society as it becomes ever more complex. We need more specialists in the nonsciences in a great variety of fields having to do with human relations, with human organization, and with those fields through which the values and the experience of the past are brought to bear on the present. We must train these people so that the breadth of their understanding makes it safe to entrust the future to them.

I am persuaded that this can be done only by some rather searching reevaluations of the curriculum in all fields. It is important, I believe, that the leadership in all branches of the curriculum inquire into what the fundamental goals of its field really are and determine whether courses, as now designed, really contribute toward that goal. Perhaps in the field of physics, which was my own field of professional concentration, the force of this admonition has begun to be recognized by many. Physics as now taught in 90 percent of the schools and colleges, at least, differs little from the way it was taught a quarter-century ago. And yet physics has developed more and changed more in the past quarter-century than in the preceding 300 years, back to the time of Newton. There is at present a rather fundamental attack on this problem of reevaluation in physics, centering around Jerrold Zacharias of Massachusetts Institute of Technology, and already several hundred thousand dollars have been committed for the project. A similar profound reevaluation and regrouping is under way in mathematics.

The aim here is by no means to create easier or more entertaining courses. On the contrary, it should be to create courses which are inherently so meaningful and challenging that they reach out and absorb the interests of competent students.

Thus there is a reevaluation under way in at least some of the scientific subjects which, it is hoped, could relate these subjects more clearly to the contemporary scene and could much more efficiently present to nonscience students the contributions of science to modern life and thought.

But similar reevaluations are surely in order in other fields. One of the purposes of education is to bring to the student a knowledge and appreciation of the intellectual heritage which is his and of the human experiences which have relevance for the modern world. If this be the essence of humanism and the function of the humanities, then it must be admitted that not all of the courses given in the name of the humanities serve this end as well as they might. This fact has more frequently been noted, of late, by humanists themselves. Too many of the courses classified under the heading of "the humanities" are, in fact, primarily introductory courses, preparatory to complete specialization in the subject matter rather than a sensitive synthesis of human values and human experiences growing out of the agelong history of humanity's struggles with its problems.

B. C. Keeney, president of Brown University, himself a humanist and a medievalist, expressed this need for reevaluation of the humanities pointedly in speaking to the medievalists a year ago when he said (*3*): "The real purpose, however, of undergraduate study of the humanities is to acquaint students with the role and scope of the emotions, and to lead them to make judgments of value and of ethics. Yet I have heard a distinguished member of the Medieval Academy of America, speaking of his course in art in general education, say that he left all judgments of value to the humanists. They are mathematicians, logicians, semanticists, or historians of the scientific rather than the humane persuasions. What scientific historian will make a judgment of value in one of his courses. . . .? Fundamentally, it is the wistful imitation of the scientists by humanists that has robbed the humanities of their humanity and has made them the jejune and learned nonsense that they now are."

He went on to say that "the humanities must be learned (for they can not be taught) as human and humane things in life, not as masses of assorted data and as skeletons without flesh."

If, indeed, this type of reevaluation occurs it will surely be recognized that science itself is one of the great areas of humanism, since certainly it represents one of the great contributions of the human intellect over the centuries.

In closing, let me state again that in the modern age we must be increasingly aware of the imperative role of science and invention, of technology and technologic education, in the service of the community and the state. We must be aware that the welfare and security of our society depend on technology, and that correspondingly increasing numbers of specialists in their fields are necessary. This is going to require some fundamental reconsiderations of practices and some reevaluation of concepts in both lower and higher levels of education. Particularly we must inquire into the very nature and materials of the educational process to see whether the imperative requirements of our age are being met in a world which leaves less and less room for complacency and for misdirection.

I have always had great respect for American youth, growing out of a lifetime spent in education. There is one great comfort I think we can take: if we who shape education do our part, the youth of the land will do theirs to meet the challenge of the present and the future.

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Thyroid Radioactivity after Nuclear Weapons Tests

C. L. Comar, Bernard F. Trum, U. S. G. Kuhn III,

R. H. Wasserman, M. M. Nold, J. C. Schooley

In 1954 it was shown that nuclear weapons tests had produced radioactive materials (primarily iodine-131) that were accumulated and detectable in the thyroid glands of livestock in the United States (*1*). Further survey values for both man and animals have been presented in U.S. Atomic Energy Commission reports and in the open literature (*2–4*). The magnitude and pattern with time of radioactivity levels in the thyroids are of interest because (i) there is provided an alert to any build-up of potentially hazardous levels; (ii) as relationships are developed, radioiodine measurements could serve as a sensitive monitoring system for other fallout nuclides less easily detected in the biosphere; (iii) information may be obtained on the movement of radioiodine particularly in the biological system; and (iv) there could be an interference with medical diagnostic tests that employ low levels of radioiodine. This paper (*5*) summarizes the information that has been obtained on the levels of iodine-131 in human and cattle thyroids and presents an estimate of milk levels in the United States during the period from January 1955 to December 1956. Correlation with known bomb tests is noted, and some inferences are drawn about routes of exposure.

Procedure

Human thyroids from autopsies were submitted by pathologists from locations as noted by acknowledgment (*6*). In general, the thyroids were predominantly from persons more than 50 years old, and it was necessary to determine whether the radioiodine content was affected by the age of the person. Samples from the New Orleans area permitted comparisons of thyroid radioactivity in various age groups; thyroids from older persons showed slightly higher values than those from younger, and the few samples from children were not generally higher than those from other age groups. In addition, no differences were observed between samples from accident cases and those from patients hospitalized for a matter of weeks prior to autopsy. Thus, the sampling was considered as conservatively representative of the total population. Cattle samples were taken at the slaughter house, usually from calves or yearlings.

All thyroid glands were shipped in formalin and were processed in a standard manner upon receipt. The thyroids were washed, blotted dry, trimmed of extraneous tissue, cut into small pieces, placed in a tared aluminum cup, and weighed. The samples were dried for several hours at 100°C, reweighed, and then pelleted in a Carver laboratory hydraulic press into a cylinder about 16 millimeters in diameter. The pellet was placed in a test tube for counting. The dried pellets gave more uniform samples than did fresh tissue and permitted more sample to be presented to the sensitive volume of the detector. Recovery experiments showed that losses during processing did not exceed 10 percent; formalin-fixed weights were about 5 percent higher than wet weights. The results are expressed as millimicrocuries per gram of tissue (fresh weight) (mμc/g) calculated back to the date of death. The counting was usually done between 1 and 2 weeks after death. The samples as counted represented, on the average, about 10 to 15 grams of fresh tissue, ranging from 3 to 30 grams for both man and cattle.

For the most part, a commercial well crystal (background, 300 counts per minute; 1 millimicrocurie of iodine-131, 909 counts per minute) was employed, although some samples were counted with a 3-inch crystal and a single-channel analyzer (background, 10 counts per minute; 1 millimicrocurie of iodine-131, 394 counts per minute). Counts were considered significant when the counting rate was 2 to 3 times its standard deviation. As a rule, the counting rate was not significant when the sample contained less than 0.005 millimicrocurie of iodine-131. The usual calibration and standardization procedures were employed. Occasionally, the gamma-ray spectrum and half-life were determined and were found to be in agreement with the characteristics of iodine-131. Muscle samples showed no detectable activity under the conditions of measurement that could not be ascribed to radiopotassium.

Results

The over-all results are presented in Fig. 1 and represent the human and cattle samples averaged by 2-week periods. The curves were drawn by inspection to aid in the visualization of the general pattern; broken lines indicate periods during which samples were not taken. All the human samples were averaged except those from the Salt Lake City station. The cattle samples up to June 1955 represent averages of all continental stations listed in Table 1 except those from the Nevada-Utah area; thereafter, collections were made only from Omaha, Nebraska.

It is first noted that the pattern of levels is correlated with known weapons tests. The peak in mid-1955 was undoubtedly a result of the United States continental tests in the spring of 1955. The smaller rise with a peak near January 1956 presumably reflected a contribution from Soviet tests. The general rise during the latter half of 1956 could have resulted from United States, British, and Soviet activities.

From comparison of the pattern of cattle and human values, there seems little question about the common source of radioactivity. The cattle values were significantly greater than those of man ($P < 0.01$) and were increasingly higher at the higher levels. An indication of the route of entry of the radioiodine into cattle is given in Table 2. Through the cooperation of George K. Davis of the Florida Experiment Station, it was possible to obtain thyroids from six animals that had been barn-fed in central Florida for about 3 months on feed that could have contributed only small amounts of iodine-131. For comparison, thyroids were sent from two animals that had been allowed to graze normally on nearby pastures. It is apparent that at least 70 percent of the iodine-131 in the grazing animals had been contributed by the pasture. This observation is in disagreement with other reports (*2*) that suggest inhalation as the major source of contami-

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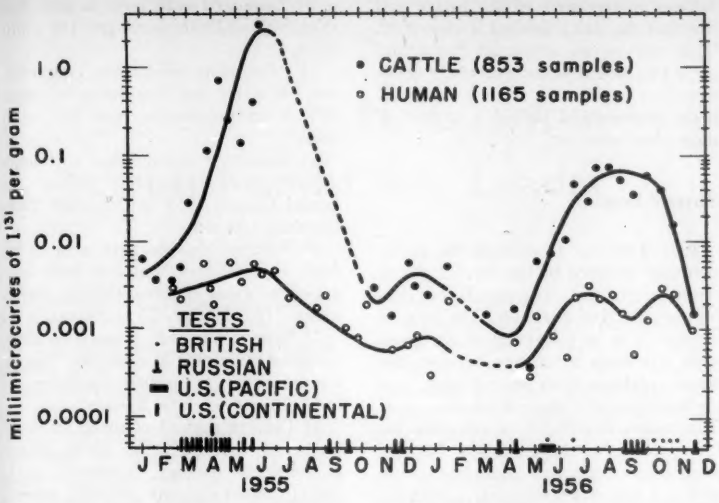

Fig. 1. Summary of iodine-131 levels in human and cattle thyroids as correlated with nuclear weapons tests during 1955–1956.

nation for cattle; indirect evidence (*3*) implicating food as the principal source of iodine-131 in cattle provides support for the findings presented in this paper.

A comparison of cattle values shown in Table 2 and the average human level is of interest. If the concentration in the thyroids of the barn-fed animals is corrected by a factor of 5 to account for the difference in respiratory tidal volume between the two species, a value of 0.0024 millimicrocurie per gram is obtained. As noted from Fig. 1, this is in fair agreement with the human values for this period (late June 1955). Since it is reasonable to assume that the iodine-131 burden in the barn-fed animals resulted primarily from inhalation, this supports the idea that the human burden may in large measure result from inhalation.

Table 1 presents the data for May 1955, a peak month. For ease of interpretation, the results have been lumped by geographical regions. Despite the fact that generalizations about regional differences are not particularly meaningful because of arbitrary factors, some trends are apparent. As expected, the levels from the region near the Nevada test site were higher than those from the rest of the country. The human values were essentially the same all over the country except for the Nevada-Utah area. The cattle samples, in contrast, appeared to show more differences between regions, with lowest values from the West Coast and highest from the Southwest. This may be related to the different routes of assimilation of fallout iodine-131 by man and grazing animals. Cattle samples from abroad were generally low.

Particular attention is called to the large spread of values. This is illustrated in Table 3, which presents the percentile distribution of samples for May 1955 and August 1956, two peak months. For instance, during the May peak, 30 percent of the human samples had less than 0.0008 millimicrocurie per gram, whereas 11 percent had more than 0.01 millimicrocurie per gram; the spread was even greater for the cattle samples. As a further example, out of ten cattle samples during the period 1 to 15 October 1956, eight ranged between 0.004 and 0.09, whereas the other two samples were 1.6 and 2.0 millimicrocuries per gram. There are obvious reasons for variations within sample groups; however, the occurrence of occasional high values requires further study to determine how much reliance can be placed on the ideas of uniform distribution or uniform accessibility of fallout materials. Similar interpretation of occasional high values could not be made for the human samples because any such value was automatically suspect on account of the widespread medical uses of iodine-131; in compilation, such values were eliminated from averages after the institution of origin confirmed that the individual had been treated with iodine-131.

Milk

It seemed important to consider milk as a route by means of which fallout radioiodine could be transmitted to the human population, especially to children, since appreciable amounts (up to 6 percent) of radioiodine ingested by the dairy cow appears in the milk (*7*). Samples of milk (100 milliliters) from the same areas as the sources of the cattle thyroids were collected from February to June 1955. No activity was detectable in these milk samples, indicating that the concentration of iodine-131 must have been less than about 0.01 millimicrocurie per 100 milliliters when the milk was secreted. From some unpublished experiments by F. W. Lengemann, it was shown that in two dairy cows receiving iodine-131 every day there was, at steady state, 0.74 and 1.3 percent of the daily dose per kilogram of milk and 30 and 65 percent of the daily dose in the thyroid gland, respectively. It is estimated from these values that the levels of iodine-131 in milk from dairy cows

Table 1. Iodine-131 content of human and cattle thyroid glands during May 1955.

Location	Human (mμc/g)	Cattle (mμc/g)
Nevada-Utah (eight human samples from Salt Lake City; two cattle samples from Nevada and southern Utah)	0.030	46; 0.15
West (27 human samples from Los Angeles and Portland; five cattle samples from California and Washington)	0.0048	0.086
South and Southeast (39 human samples from Louisville, Oak Ridge, and New Orleans; nine cattle samples from Louisiana, Tennessee, Texas, and Florida)	0.0055	0.46
North and Northeast (37 human samples from Minneapolis, Chicago, Boston, and New York; six cattle samples from South Dakota, Missouri, and Massachusetts)	0.0032	0.18
Abroad		
Panama (two cattle samples)		0.10; 0.082
Hawaii (two cattle samples)		0.11; 0.081
Germany (two cattle samples)		0.0019; 0.0056
Greece (one cattle sample)		0.013
French Morocco (one cattle sample)		0.047
Tokyo, Japan (one cattle sample)		0.0092

Table 2. Contribution of pasture to iodine-131 burden of cattle.

Animal number	Millimicrocuries of I^{131} per gram of tissue (fresh weight)
Barn-fed cattle	
3	0.0092
5	0.012
13	0.012
100	0.013
101	0.013
102	0.011
Avg.	0.012
Pasture-fed cattle	
16	0.042
18	0.039
Avg.	0.041

having the thyroid levels shown in Fig. 1 should have been about 0.2 millimicrocurie per 100 milliliters at the 1955 peak and averaged about 0.02 for the whole period. These values are higher than those found, probably because dairy cows usually consume older feed than do the cattle reported in this article. The data in this article do not permit estimations of the contribution of iodine-131 carried in milk, although the low milk levels found and the fact that the levels in younger age groups were not significantly higher would indicate this route to have been of minor importance. The contribution of milk is, of course, decreased by the physical decay between the time the fall-out is deposited on the forage and the time the dairy product is consumed. This may be an important factor and should be looked at more carefully under situations where milk from grazing animals is consumed within a matter of days after secretion.

Table 3. Examples of spread in iodine-131 levels in human and cattle thyroids. All continental samples except from Nevada-southern Utah area.

	May 1955	August 1956
Human		
No. of samples	101	60
Percentage of samples with		
Less than 0.0008 mμc/g	29	62
Betweeen 0.0008 and 0.01 mμc/g	60	35
More than 0.01 mμc/g	11	3
Cattle		
No. of samples	20	22
Percentage of samples with		
Less than 0.001 mμc/g	10	0
Between 0.001 and 0.1 mμc/g	40	86
More than 0.1 mμc/g	50	14

Thyroid Doses

It is of interest to estimate the radiation dose received by the thyroid glands of the human and cattle populations during the period of this study. The level of iodine-131 in an individual at any given time represents a balance between the intake, perhaps from several tests, and the biological and physical removal rates. This makes it difficult to calculate infinity dosages in the usual way (*8*). By integration of the area under the curves in Fig. 1 and estimation that 1 millimicrocurie of iodine-131 per gram of tissue delivers about 0.012 rep per day, it is calculated that the total dose from the iodine-131 beta rays, delivered over the 23-month period to the thyroid gland, was about 3 rep for cattle and 0.01 rep for man. In considering thyroid dosages, it is necessary to take into account the contribution of short-lived isotopes of iodine. This situation has been analyzed by Dunning (*8*), who shows that, up to 10 hours after detonation, the short-lived radioiodines may contribute about 4 times the iodine-131 dose and by 2 days about equally, but that after 10 days the contribution of the short-lived activities becomes negligible. It is not possible to correct the over-all dose of iodine-131 for the contribution of the short-lived activities, but in any event the total dose could not have been greater than 4 times the average dose from iodine-131 (4 × 0.01 rep) for man and was probably much less.

There seems to be little question that the levels of radioiodine introduced into the biological cycles by weapons tests during 1955 and 1956 are far below those that are expected to produce any observable effects. This can best be demonstrated by comparison of levels found with the official maximum permissible values and with findings on the lowest levels of radiation or of iodine-131 that could possibly have produced detectable changes. Such a comparison follows.

1) Average peak level observed in man, 0.005 millimicrocurie per gram.

2) Maximum permissible level in man for continuous exposure (*9*), 15 millimicrocurie per gram.

3) Estimated peak level in milk, less than 0.01 millimicrocurie per 100 milliliters.

4) Maximum permissible concentration in water for continuous exposure (*9*), 3 millimicrocuries per 100 milliliters.

5) Estimated average dose to human thyroid from radioiodine during the period January 1955 to December 1956, less than 0.04 rep.

6) External dose to neck area in infants and children that has been suggested as cause of later thyroid malignancy (*10*), 200 to 725 roentgens.

7) Dose to thyroids of sheep on daily intake of iodine-131 at which no damage was observed (*11*), 936 roentgens (3 roentgens per week for 6 years).

8) Dose to thyroid of sheep on daily intake of iodine-131 at which minor physiological change occurred (*11*), 3000 to 5000 roentgens (over 2½ years).

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H. L. Lyon, Scientist and Civic Leader

On 15 May 1957 Hawaii lost, through the death of Harold Lloyd Lyon, a great leader in agriculture, forestry, and civic improvement.

Born in Hastings, Minnesota, in 1879, Dr. Lyon received his Ph.D. degree in botany and plant pathology from the University of Minnesota in 1903. He joined the botany staff of his alma mater in 1901 and soon advanced to the rank of assistant professor. While botanizing in the northern wilderness of Minnesota and Canada, he developed a keen interest in the ecological factors that control the survival of species.

In 1907 Lyon joined the Experiment Station of the Hawaiian Sugar Planters' Association, a union that proved to be of great mutual benefit. In this young territory he found opportunities to use his talents in many varied applications of a sound scientific training. One of his first assignments, on reaching Hawaii, was to ascertain, if possible, the reasons for the dramatic decline of the native forests on the steep watersheds of the islands. It became apparent to him, in the course of this study, that the highly specialized indigenous species were no longer able to thrive under the altered ecology that had been brought about by the introduction of cattle, goats, pigs, and aggressive grasses. To provide a basis for reforestation, Lyon developed a plant introduction program, in the course of which more than 8000 plant species were brought to Honolulu from other tropical regions and tested, in trial plantings, under the varied climatic and soil conditions of the islands.

To implement this program of plant introductions, Lyon enlisted the aid of friends throughout the world, and he himself traveled extensively into the rain forests and tropical jungles. On most of these trips he was accompanied by his wife, who was also a dedicated botanist and humanitarian. By 1930 it had been demonstrated that enough trees and shrubs had been introduced and tested to enable the foresters to select plants appropriate for planting in any area of these islands where there were denuded watersheds.

Crises resulting from destructive sugar-cane diseases have occurred at some time in almost all important sugar-producing areas. In 1910, Lyon began his study of Fiji disease, in Fiji and in Java, and gave the first accurate description of its nature. He published several detailed papers on major cane diseases and was one of the first to appreciate the potentialities of wild relatives of sugar cane in breeding for disease resistance. This program was augmented in 1926 by the addition of a geneticist to the station staff. From this beginning has grown one of the most successful cane-breeding programs in the world. As a further protection against new diseases, a substation was established in 1946, in American Samoa, for testing new Hawaiian varieties of sugar cane for resistance against diseases that are foreign to Hawaii.

As an organizer and administrator, Lyon's influence has been broad. In 1914 he organized a program of research for the Association of Pineapple Canners, which led to the establishment of the present Pineapple Research Institute. He helped to organize the Hawaiian Botanical Society, the Pacific Orchid Society, and the Hawaiian Academy of Science.

In 1930 he accepted the position of director of the Foster Gardens, a botanical garden and park bequeathed to the city and county of Honolulu. During the preceding 12 years he had had much to do with the landscaping of the area and the planting of new importations. This garden now has by far the largest and best orchid collection of any public institution in America.

In 1919 Lyon began the planting of a 124-acre tract, purchased by the Hawaiian Sugar Planters' Association, at the head of Manoa Valley. In 1953 this arboretum was donated by the association, at Lyon's suggestion, to the University of Hawaii. In his will, Lyon provided that the proceeds of his estate should eventually be used for the maintenance and development of the Manoa arboretum. The board of regents of the University of Hawaii recently voted to rename the area the "Harold L. Lyon Arboretum." They also adopted the following resolution: "Future generations of students and natural scientists will remember him with gratitude, as will the citizens of the Territory, who are indebted to him for the preservation of the moisture-retaining watershed and the beautification of the Islands that he loved."

In 1936 he accepted the directorship of the Experiment Station which he had joined 29 years earlier. Probably no man has ever stepped into the top position of a research organization with a more well-rounded knowledge of the work he was to direct.

Lyon's breadth of interest is indicated by the titles of his more than 50 publications, which discuss cane diseases, garden crops for Hawaii, exotic trees in Hawaii, methods in plant physiology, and so on. Like so many busy men, he found little time for polishing finished papers, and much of his work and thought was never recorded beyond the stage of handwritten notes or mimeographed copy for presentation to local organizations.

He believed that the library is the essential core of all institutions of learning and gave much time to assembling a fine collection of botanical works. In recognition of his sustained support, the new library building at the Experiment Station is dedicated to Harold Lloyd Lyon.

Among the honors conferred on Lyon were the honorary degree of doctor of science, by the University of Hawaii; the Outstanding Achievement medal, by his alma mater; and the George Robert White medal of honor, by the Massachusetts Horticultural Society.

Age brought no diminution in Lyon's enthusiasm for new projects. In his last printed paper (1956) he wrote, "These Islands should have many gardens. Obviously the master plan for our enterprise should include numerous gardens on each and every one of the inhabited islands in our territory . . . located at all elevations from sea level to 10,000 feet. Such a group of gardens would afford a greater abundance and a larger assortment of plant material for research and educational purposes than could be assembled anywhere else in the United States." The greatest satisfaction of his later years came from observing the successes of the plants to which he had devoted his life—sugar cane, pineapples, orchids, and the host of trees, shrubs, and vines which are contributing so much to the economy and the beauty of the islands.

GEORGE O. BURR
Experiment Station of the Hawaiian Sugar Planters' Association, Honolulu

News of Science

NSF Report on Exchange of Graduate Students

Approximately 34,000 students from other nations were studying in institutions of higher learning in the United States during 1953–54—equal to the combined enrollment of foreign students in all universities of Western Europe. Thirty years earlier, the universities of Western Europe attracted three times as many foreign students as those in the United States.

These data are part of a new report by the National Science Foundation on exchange of foreign and United States graduate students in the sciences, engineering, and other fields. The data are based on surveys of the Institute of International Education, New York City, and an NSF survey on graduate enrollment. The analysis is designed to complement a report of graduate-student enrollment and stipends in the academic year 1953–54, to be published by the foundation this summer.

Numbers of foreign students studying at United States colleges and universities have increased steadily since World War II, until, in 1955–56, 36,500 were reported, of whom 13,600 (37 percent) were at the graduate level. The increase is indicative of the demand for professional and technical personnel in all parts of the world, as well as of the fact that United States institutions of higher learning have achieved internationally recognized status. While the majority of foreign students in this country are studying at the undergraduate level, United States students abroad are predominantly at the graduate level.

Until 1946, the total number of foreign students at United States colleges and universities never exceeded 10,000, of which no more than 2000 to 3000 were graduate students. Since 1946, the number of foreign students in the United States has more than trebled. In 1953–54 about one-third of the foreign students here were studying at the graduate level (approximately 5 percent of the total U.S. graduate enrollment of 250,000). They were predominantly studying in the natural sciences and engineering. On the other hand, the approximately 9500 U.S. students abroad were primarily studying in the humanities, chiefly at the graduate level.

In 1953–54, about 5000 (50 percent) of foreign graduate students in America were from the following seven countries: Canada, China, India, Philippines, Mexico, Japan, and the United Kingdom. Slightly less than 3000 of these were from the Asian countries and adjoining islands. Since 1920, Asian students have outnumbered Europeans in American institutions. While the majority of all our foreign students have been from Asia, few Americans have gone to Asia to study. Of the Europeans studying in this country, the British have been the most numerous. Of Americans studying abroad, at both the graduate and undergraduate level, approximately 5600 (60 percent) were in Europe and 2800 (30 percent) in Canada and Mexico. The European countries chosen by most students were Italy, Switzerland, France, and the United Kingdom.

Of the approximately 10,000 foreign graduate students in this country in 1953–54, 5150 (52 percent) were in the fields of natural sciences and engineering. Only 26 percent of all American graduate students in this country were in these fields. Of American students in foreign schools, 13 percent were studying natural sciences and engineering. The humanities accounted for 62 percent; the remaining 25 percent were studying psychology, social sciences, education, and other fields. In recent years as many as 1800 Americans have been enrolled in foreign medical schools, while only 100 foreign students were in American medical schools.

Financial support for exchange students comes from various sources. Seventy-seven percent of foreign graduate students received all, and another 7 percent part, of their support from personal or nongovernmental sources; only 16 percent received full support, and 7 percent partial support, from U.S. or foreign governments. Of American graduate and undergraduate students abroad in 1954–55, 53 percent were estimated to have some major source of governmental or private support—32 percent received G.I. benefits; 11 percent, U.S. Government scholarships and fellowships; 6 percent were supported by private foundations and universities; and 3 to 4 percent were studying on special junior-year-abroad arrangements.

The complete report, *Reviews of Data on Research and Development, No. 4, Exchange of Foreign and American Graduate Students in the Sciences, Engineering, and Other Fields,* may be obtained by writing to the National Science Foundation, Washington 25, D.C.

Vaccine for Goat Brucellosis

The first effective vaccine against brucellosis in goats has been developed at the University of California by Sanford Elberg, professor of bacteriology. The vaccine may also prove effective in sheep, which are attacked by the same species of bacteria that attacks goats, *Brucella melitensis*.

The vaccine was tried on some 40 female goats. One group was vaccinated in August or September, while a second group remained unvaccinated. In October–December the animals were bred, and 1 month later all of them were infected with a virulent strain of *Brucella melitensis*. Every one of the unvaccinated goats aborted; the vaccinated animals gave birth to healthy kids, and both mothers and kids were uninfected. The results have just been confirmed by a group of scientists in England, led by A. W. Stableforth of the Ministry of Agriculture and Fisheries Laboratory at Weybridge.

The new vaccine is expected to bring important benefits, particularly to Latin American and Mediterranean countries, where goats and sheep are of major economic significance. The World Health Organization and the U.S. Public Health Service helped finance Elberg's work.

Cause of Multiple Sclerosis

The National Multiple Sclerosis Society has announced that investigators at Montefiore Hospital, New York, and the University of Pennsylvania, will attempt to verify the recent findings of Rose R. Ichelson, Philadelphia bacteriologist, who reported isolating and culturing a spirochetal organism from spinal fluid of multiple sclerosis patients. She believes that the spirochete (*Spirochaeta myelophthora*) is the cause of the disease that has puzzled scientists for 125 years.

The tests at Montefiore Hospital will be under the direction of Alfred Cohn, microbacteriologist at the hospital. The University of Pennsylvania tests will be directed by Edward D. DeLamater. In addition to the tests being conducted under Multiple Sclerosis Society auspices, at least five other laboratories have

tentative plans for testing the findings.

Inquiries about the research should be directed to the National Multiple Sclerosis Society, 257 Fourth Ave., New York 10, N.Y., not Montefiore Hospital or the University of Pennsylvania.

Classification System for Carbohydrates

Conventional chemical names of carbohydrates are cumbersome and are not always sufficiently distinctive for convenient structural classification. To overcome these disadvantages, H. S. Isbell of the National Bureau of Standards has developed a simple classification system in which each carbohydrate is assigned a code number that defines its structure and configuration. By inspection of the code numbers, or by a punched-card technique, related carbohydrate derivatives can be selected readily from a heterogeneous collection.

The numerical classification system was worked out in connection with a program, sponsored at the bureau by the Office of Naval Research, for investigation of the structure, configuration, and ring conformation of the sugars and their derivatives by infrared absorption measurements. Although devised primarily for comparing infrared spectra, the system can be used for classifying structurally related carbohydrates for a variety of purposes. It should be useful to research workers who need to assemble lists of structurally related compounds for any reason.

Planned Parenthood

More than 156,000 American families went to Planned Parenthood centers in 1956 for birth control services, marriage education, and infertility therapy, according to the annual report of the Planned Parenthood Federation of America. The report, which covers the work of the national federation and its 106 local affiliates throughout the country, noted general increases in service and educational activities. Particularly striking was a gain of 19 percent in the number of people, chiefly engaged couples and newlyweds, who went to Planned Parenthood for marriage education and counseling.

However, the report comments that "Recent estimates indicate that well over 10 million U.S. married adults in their childbearing years are uninformed or misinformed about medically approved contraception." The development of ways to bring accurate information to these groups was defined as the central problem facing the family planning movement in America.

In a quick roundup of experiments with newer methods of communications which Planned Parenthood groups have been conducting, the report cited a variety of different projects:

In Washington, D.C., a social worker is making a person-to-person approach to mothers in low-income housing developments.

In Kansas City volunteers are distributing informational publications at factory gates.

In New York City a program oriented toward Spanish-speaking groups has increased the patient load 39 percent.

In Kentucky a nurse-midwife team takes along information and supplies on regular tours by jeep through remote mountain areas.

The federation's educational cartoon book achieved during its first 6 months the largest distribution of any recent information booklet about birth control.

"These programs showed that much more widespread use of existing contraceptive methods can be achieved in the U.S.," the report observes. "Even more apparent, however, was the urgent need to develop simpler, less expensive methods if the goal of 'universal acceptance' of family planning is to be reached."

The report noted the formation of a strong PPFA Biologic Research Committee, led by Carl G. Hartman, director emeritus of the Ortho Research Foundation, to head the federation's program of research in methods of contraception and infertility treatment. During 1956, the federation supported eight research projects in this field.

To make possible these expanded programs, the federation and its affiliates raised close to $1.5 million in contributions from 52,736 supporters throughout the country, a 20-percent increase over 1955.

Soviet Medicine and Surgery

The Excerpta Medica Foundation will soon begin to publish English translations of significant Soviet publications on medicine and surgery. The work is being undertaken under contract with the National Institutes of Health, Bethesda, Md. The foundation's translators will work in cooperation with Soviet medical authorities in culling notable developments from Soviet medical and surgical publications.

Excerpta Medica is a nonprofit organization that abstracts and disseminates for medical science the latest writings in every field of medicine. Its work is aided by the National Foundation for Infantile Paralysis, the American Cancer Society, the National Heart Institute, the National Multiple Sclerosis Society, and the Muscular Dystrophy Associations of America. The foundation recently established a branch office at the New York Academy of Medicine, 2 E. 103 St., New York, N.Y. Its main headquarters is in Amsterdam, Netherlands.

News Briefs

The Washington office of the Social Science Research Council will be permanently closed at the end of July and the staff—Elbridge Sibley, Bryce Wood, and Joseph B. Casagrande—transferred to the main office at 230 Park Ave., New York 17, N.Y. After 1 Aug. inquiries concerning fellowships and grants should be directed to New York.

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A course in fine particle techniques will be conducted at the Public Health Service's Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, 5–9 Aug. Enrollment is by application. There is no tuition requirement.

* * *

Mrs. Oakes Ames of North Easton, Mass., has deposited the Ames Botanical Library at the Texas Research Foundation, Renner, Tex., and provision is being made by the foundation to acquire it. The library contains more than 4000 volumes and many unbound items that the late Prof. Oakes Ames of Harvard University collected during his lifetime of botanical research.

* * *

The discovery of a Byzantine castle thought to have been captured by King Richard the Lion-Hearted in 1191 has been announced by the Cyprus Antiquities Department, Nicosia, Cyprus. The fortress was discovered by archeologists excavating some ruins overlooking Paphos Harbor. Also among the ruins was a building with mosaics of a style used in 6th century churches.

* * *

The College of Medical Evangelists School of Dentistry has become the nation's 43rd approved dental school, according to an announcement of the American Dental Association. Approval was granted just a few days before the graduation of the school's first class, which totaled 39 students.

* * *

The U.S. Atomic Energy Commission has issued a 200-page proceedings of a conference on engineering education and nuclear energy that was held last September in Gatlinburg, Tenn., under the auspices of the AEC, the Oak Ridge Institute of Nuclear Studies, Oak Ridge National Laboratory, and the American Society for Engineering Education. W. W. Grigorieff, chairman of the University Relations Division of the Oak Ridge Institute of Nuclear Studies, is editor of

the volume, TID-7527, which is now on sale for $1 by the Office of Technical Services, Department of Commerce, Washington 25, D.C.

NSF Postdoctoral Awards

Applications will be accepted through *3 Sept.* by the National Science Foundation for a second group of postdoctoral fellowships to be awarded during 1957, both in the regular and senior postdoctoral programs. Fellowships will be awarded in mathematical, physical, medical, biological, engineering and other sciences, including anthropology, psychology (other than clinical), geography, certain interdisciplinary fields, and areas of convergence between the natural and social sciences. Names of successful fellowship candidates will be announced on 16 and 17 Oct.

To be eligible for these awards, candidates must be citizens of the United States with special aptitude for advanced training and must hold the doctoral degree or have the equivalent in training or experience. In addition, candidates for the senior postdoctoral program must have at least 5 years' experience beyond the science doctorate.

A stipend of $3800 per year will be awarded to successful applicants in the regular postdoctoral program. Dependency allowances will be made to married fellows. A limited allowance to aid in defraying a fellow's cost of travel will be paid as well as tuition and fees.

Annual stipends to a maximum of $10,000, adjusted to match as closely as feasible the regular salaries of the award recipients, will be awarded under the senior program, and the recipients of these awards will engage in study or research in an accredited nonprofit institution of higher learning in the United States or abroad. A limited allowance to aid in defraying costs of travel for a fellow and his dependents will also be available.

Proposed Legislation

Of the many bills introduced in Congress, some have a special relevance to science and education. A list of such bills introduced recently follows:

HR 7875. Establish the Civic Health through Athletic and Mental Proficiency Society of the U.S. Huddleston (D Ala.) House Education and Labor.

HR 7938. Protect the public health by amending Federal Food, Drug, and Cosmetic Act to provide for safety of chemical additives in food. Sullivan (D Mo.) House Interstate and Foreign Commerce.

HR 7914. Amend Career Compensation Act of 1949 to provide incentive pay for human test subjects. Reece (R Tenn.) House Armed Services.

HR 7934. Authorize Federal assistance to the states and local communities in financing a program of atomic and disaster shelters in the nation's schools. Metcalf (D Mont.) House Armed Services.

H Res 273. Provide that a select committee be appointed to conduct a full and complete investigation and study of the use of chemicals and other additives in food, medicine, and beverages with a view of ascertaining what deleterious effects such chemicals have on human life and health. Teller (D N.Y.) House Rules.

HR 7880. Establish on public lands of the U.S. a national wilderness preservation system for the permanent good of the whole people; provide for protection and administration of areas within this system by existing Federal agencies and for gathering and dissemination of information to increase the knowledge and appreciation of wilderness for its appropriate use and enjoyment by people; establish a National Wilderness Preservation Council. Porter (D Ore.) House Interior and Insular Affairs.

HR 7884. Encourage discovery, development, and production of manganese-bearing ores and concentrates in the U.S., its territories and possessions. Mills (D Ark) House Interior and Insular Affairs.

Scientists in the News

ISIDOR I. RABI, Nobel laureate and professor of physics at Columbia University, and ROBERT REDFIELD, professor of anthropology at the University of Chicago, are the scientist members of a new ten-man committee that has been established by the Fund for the Republic to "study contemporary American life with a view to determining the conditions under which a free society may best be maintained."

The ten consultants will meet several times a year for extended sessions of study and analysis. They will direct the collection of factual and analytical material and are expected to publish findings and conclusions from time to time.

ENGLEHARDT ECKHARDT, a physicist who was formerly vice president in charge of research for the Gulf Research and Development Company, Pittsburgh, Pa., has been appointed assistant director of the National Science Foundation for the Division of Mathematical, Physical, and Engineering Sciences. RAYMOND J. SEEGER, who has filled the position in an acting capacity, will continue as deputy assistant director for the division. Eckhardt is well known for his work in geophysics, ballistic measurements, and building acoustics.

The Navy has announced that the largest group award that has been made in the Federal Civil Service, $20,825, has been given to a group of employees at the Naval Research Laboratory in Washington, D.C., for their role in improving interceptor armament-control systems. PETER WATERMAN, an electronic scientist with the Radar Division at NRL and the key figure in directing this work, received $10,000. Forty-four other employees who worked with Waterman shared the remaining $10,825, which was distributed according to the significance of their contributions. Ten employees in the group received the second highest amount, $700 each; the remaining 34 received either $150 or $75.

R. M. WHALEY, executive assistant head of Purdue University's department of physics, has been granted a leave of absence for 1 year to serve as director of the Advisory Board on Education of the National Academy of Sciences in Washington, D.C., effective 1 Aug. He will help direct the efforts of the interdisciplinary board, which will serve as the principal agent of the National Academy in all matters relating to education in the sciences.

Among the responsibilities with which the board is charged are the following: to provide leadership for the establishment of scholarly criteria in science education; to cooperate with and assist the nation's professional societies in planning for science education at all levels; to anticipate future national requirements for scientists and engineers in all fields and to relate these requirements to the demands for education in the grade school, high school, college, and graduate school; to provide a bridge between the sciences and the other learned professions in matters of education in order to promote understanding and develop continuing cooperation among and between the schools, industry, and government.

LAWRENCE A. HYLAND, vice-president and general manager of Hughes Aircraft Company, Culver City, Calif., has received the 1957 Pioneer Award of the Institute of Radio Engineers' professional group on aeronautical and navigational electronics. He was honored for his demonstration in the early 1930's that radio waves will reflect from objects, a basic radar discovery. He first observed the principle of radar detection of aircraft in 1931 while he was an associate engineer in the Naval Research Laboratory, Anacostia, Md.

HAROLD JESKEY, professor of chemistry at Southern Methodist University, and SAMUEL W. GEISER, head of the biology department, received faculty achievement awards during the university's recent founder's day banquet. The $500 faculty awards were instituted this year.

FRED H. RHODES, virtually the founder of Cornell University's School of Chemical and Metallurgical Engineering, became professor emeritus on 1 July. When Rhodes first taught industrial chemistry in the College of Arts and Sciences 35 years ago, chemical engineering at Cornell was almost nonexistent. Rhodes has since worked steadily for its development. Gradually chemical engineering courses were included in the chemistry department curriculum, then a university degree was offered in the field, next a separate school was established, and finally a special building was erected.

Rhodes was graduated from Wabash College in 1910 and went to Cornell for a Ph.D. He taught chemistry for a year at the University of Montana, where the physicist Harold Urey was one of his students, and for 2 years at Cornell.

He then spent 3 years with the Barrett Company, becoming director of research. In this period he developed the divided-flow method for fractionating distilling columns, and designed the first continuous fractionating column with side-stream draw-off. Returning to Cornell in 1920, he started his crusade for chemical engineering.

GEORGE T. RADO and JAMES H. SCHULMAN, both of the Naval Research Laboratory, Washington, D.C., have been presented with the annual science awards of the NRL branch of the Scientific Research Society of America. Rado, head of the magnetism branch, received the society's Pure Science Award, and Schulman, head of the dielectrics branch, received the Applied Science Award.

Among those honored recently with Knox College alumni achievement awards were WILLIAM J. BAKER, professor of urology at Northwestern Medical School; JOHN R. MAYOR, former professor of mathematics and education at the University of Wisconsin who is now AAAS director of education; and JOHN S. GRAY, chairman of the department of physiology, Northwestern University.

LOUIS C. BIERWEILER, since 1937 curator of botanical collections at Harvard University's Botanical Museum, will retire this summer. He began his career of caring for the Blaschka glass flowers at Harvard 56 years ago. He was just 15 when in 1901 he unpacked the first of the flowers, which came in regular shipments from 1887 to 1936.

The more than 800 hand-molded glass models were made by a father-and-son team of German artisans, Leopold and Rudolph Blaschka. The collection was a gift to Harvard from Mrs. Elizabeth C. Ware and her daughter, Miss Mary Lee Ware. It has been examined by more than 7 million tourists.

Bierweiler has been responsible for mounting, displaying, and repairing the specimens, which illustrate the life history of 169 plant families. The models include cross-sections of the plants, with all the details of the fine internal anatomy of the flower worked in threads and sheets of glass. Insect pollination is demonstrated by delicate glass bees, wasps, or flies crawling down glass petals covered with dots of colored glass pollen. Part of the glass flower exhibit is found in the economic botany portion of the museum. Here, the fungal infections of various fruits, including apple, pear, and strawberry, are shown.

This year's honorary degree recipients include the following:

JOSHUA H. BURN, professor of pharmacology at Oxford University, from Yale University.

HENRY J. M. CREIGHTON, retired Swarthmore chemistry professor, from Swarthmore College.

HELMUT C. DIEHL, director of the Refrigeration Research Foundation, from the University of Rhode Island.

MARION B. FOLSOM, Secretary of Health, Education and Welfare, from Swarthmore College.

WINIFRED GOLDRING, formerly Stage paleontologist with the New York State Museum, from Smith College.

ALAN GREGG, author of important medical articles, and former vice-president of the Rockefeller Foundation, from Western Reserve University.

JOHN K. LAMOND, member of the Cornell University faculty, from the University of Rhode Island.

PEARL McIVER, chief of nursing services, U.S. Public Health Service, from Western Reserve University.

ARTHUR E. PITCHER, mathematics professor at Lehigh University, from Western Reserve University.

DICKINSON W. RICHARDS, Lambert professor of medicine at Columbia University, from Yale University.

JAN OORT, director of the Observatory of Leiden and professor at the University of Leiden, from Harvard University.

DAVID SARNOFF, chairman of the board of the Radio Corporation of America, from the University of Rhode Island.

LEWIS L. STRAUSS, chairman of the U.S. Atomic Energy Commission, from the University of Pennsylvania.

RALPH M. WATERS, emeritus professor of anesthesiology at the University of Wisconsin, from Western Reserve University.

ROBERT B. WOODWARD, Morris Loeb professor of chemistry at Harvard, from Harvard University.

Recent Deaths

LAWRENCE T. FAIRHALL, Pine Orchard, Conn.; 68; physicist, retired science director of the National Institutes of Health and consultant for the U.S. Public Health Service; lectured at Yale University; 17 June.

ROLAND HAMMOND, Providence, R.I.; 81; vice president of the American Orthopedic Association, 1920–1936; 11 June.

HENRY KIRCHNER, Niagara Falls, N.Y.; 67; engineer and retired vice president and director of the Carborundum Company; developed a new silicon carbide formula; 14 June.

HENRY MEYER, JR., Montclair, N.J.; 86; engineer and retired president of Meyer, Strong and Jones, mechanical and electrical engineers; author of a textbook on steam power plants; 17 June.

WILLIAM R. MILLIS, Washington, D.C.; 58; retired deputy chief for research and development in the Navy's Bureau of Ships; 9 June.

HERBERT MORGAN, Washington, D.C.; 82; retired principal astronomer at the Naval Observatory, who had been conducting research for Yale University, chairman of AAAS Section D–Astronomy in 1935; 11 June.

DAVID R. MORTERA, Long Beach, Calif.; 71; inventor and former head of Mexico's corps of engineers; 10 June.

JOHN RABBITT, Washington, D.C.; 49; staff geologist in the office of the chief geologist of the U.S. Geological Survey; 10 June.

LYNDON F. SMALL, Rockville, Md.; 59; scientist-director in the National Institute of Arthritis and Metabolic Diseases, National Institutes of Health, and consultant to the U.S. Public Health Service; internationally known narcotics specialist who was elected to the National Academy of Sciences in 1941; editor of the *Journal of Organic Chemistry*, 1938–51; 15 June.

ALBERTO F. THOMPSON, Silver Spring, Md.; 49; head of the National Science Foundation's Office of Scientific Information, formerly chief of Technical Information Service for the Atomic Energy Commission and chemistry professor at the University of Minnesota and Massachusetts Institute of Technology; 18 June.

Reports

Duplex Nature of Reception of Simple Sounds in the Scape Moth, Ctenucha virginica

Moths of a number of families have been shown to possess tympanal organs sensitive to sounds of high frequencies which may enable the insects to escape capture by bats (*1*). Reactions to sounds are of both excitatory and inhibitory types, without obvious relationships to species or habits. Destruction of the tympanal organs abolishes most of the responses to sounds, but some individuals respond occasionally even after destruction of the organs.

In a study of reactions of the scape moth, *Ctenucha virginica* (family, Amatidae), to "pure" tones (*2*), we have found a possible explanation for responses of moths with the tympana destroyed. Briefly, *C. virginica* showed a duplex pattern of response to simple sounds: at frequencies of 150 to 15,000 cy/sec and median sound pressures of 95 to 100 db (*re* 0.0002 μbar), the reactions were generally excitatory in nature; at frequencies above approximately 15,000 cy/sec and median sound pressures of 80 to 85 db, the reactions were either inhibitory or, if excitatory, were different from those at lower frequencies. Destruction of both tympana abolished the responses to frequencies above 15,000 cy/sec, but did not affect the reactions at lower frequencies.

The methods used for testing the reactions of these moths to sounds were like those reported by us earlier (*3*). The animals were tested individually either in small cubical cages (15 cm on a side) or affixed to small wax blocks on the ends of glass rods by the dorsal wall of the thorax, with the wings free. Sounds pressure thresholds for reactions to 1- to 2-second bursts of "pure" tones of 150 to 40,000 cy/sec were determined by stimulating the insects at different sound pressures, using innate reactions to the sounds as indicators of reception. Frequencies below 150 cy/sec were produced by the equipment at intensities too low to stimulate; 40,000 cy/sec was the highest frequency that the apparatus could produce. Thus, actual frequency limits for the responses were not determined. A total of about 3000 threshold determinations were made with 21 individuals (16 males, 5 females).

At frequencies of 150 to 15,000 cy/sec, free moths usually responded by tilting the body to bring the anterior end nearer the substrate. Fixed moths jerked the antennae or legs. At 20,000 cy/sec and higher, free animals responded only occasionally and then by flicking the wings. Fixed animals, on the other hand, responded quite consistently: if not flying, they flicked the wings slightly; if flying, they usually stopped almost immediately when stimulated by the sound, as Treat (*1*) also found for this species. For 19 frequencies between 150 and 15,000 cy/sec, there were no significant differences in median sound pressure thresholds. Any sound within this wide frequency range, if it achieved sufficient intensity (above 85 to 90 db), was stimulating. At 20,000, 30,000, and 40,000 cy/sec, median sound pressure thresholds were significantly lower than at lower frequencies and essentially the same (84 to 85 db). At 15,000 cy/sec, some moths responded as at lower frequencies, others as at higher frequencies. All responded as at lower frequencies below 12,000 cy/sec and as at higher frequencies above 18,000 cy/sec. It is almost certain that frequencies above 40,000 cy/sec would stimulate the moths, for reactions occurred at that frequency at just as low intensities as at 20,000 and 30,000 cy/sec.

Bilateral destruction of the tympana abolished the responses above 15,000 cy/sec, but did not affect those at lower frequencies. With or without tympana, removal of the following parts of the body, individually or in most possible combinations, did not significantly alter the responses or thresholds at lower frequencies: antennae, legs, two-thirds of the wings, head, and abdomen. In fact, isolated heads responded by antennal movements at only slightly higher intensities than whole animals. The results, which are like those reported for the butterfly, *Cercyonis pegala* (*3*), suggest that the receptors are widespread on the body, possibly tactile hairs or chordotonal organs in the body wall.

These observations show clearly the necessity for specification of the frequencies and intensities of sounds used in studying acoustical reactions of insects. There are a number of mechanoreceptors on the insect body which are at least theoretically susceptible of stimulation by sounds. Careful control of intensities and frequencies may enable one to determine the relationships within this galaxy of receptors which enable the insect to react to its acoustic environment.

HUBERT FRINGS
MABLE FRINGS
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2. This work was supported in part by research grant No. E-802 from the National Microbiological Institute, National Institutes of Health, U.S. Public Health Service.
3. H. Frings and M. Frings, *Ann. Entomol. Soc. Amer.* 49, 611 (1956). "Pure" tones were produced by a Hewlett-Packard (200-A) audio oscillator activating a Jensen (NF-101) loudspeaker for frequencies of 150 to 4000 cy/sec and an Altec (633-A) microphone for 4000 to 40,000 cy/sec. The animals were tested in a small anechoic chamber, where they were placed 15 cm from the transducers. Sound pressures at that distance were measured for 150 to 10,000 cy/sec with a calibrated Scott (410-B) sound-level meter, and for higher frequencies by a substitution method using specially calibrated equipment of the Acoustics Laboratory of Pennsylvania State University by Fujio Oda, to whom we express our appreciation.

5 April 1957

Chlorpromazine and Reserpine Prevention of Myocardial Damage by Histamine and Serotonin

Blood-cell disintegration during clotting is accompanied by release of serotonin (*1*) and histamine (*2*). In myocardial infarction, these two agents could become active within the musculature of the heart. In order to determine whether they are liberated in quantities sufficient to cause damage, the effect of whole blood and serum, as well as of serotonin

All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table or one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in *Science* 125, 16 (4 Jan. 1957).

and histamine, was studied in the isolated and perfused rabbit heart. Reserpine (*3*) and chlorpromazine (*4*), drugs which are known to inhibit the action, respectively, of serotonin and of histamine, were investigated with respect to their usefulness in prevention of cardiac effects caused by these two agents.

For each series of experiments, five hearts of albino rabbits (weighing approximately 2.5 kg) were used. The hearts were isolated and perfused with oxygenated Locke solution (at 38°C) under constant pressure (Langendorff method). Controls were carried out (i) by briefly inserting a 27-gage needle into the left ventricular myocardium to establish the extent of trauma; (ii) by injecting 0.05 and 0.2 ml of Locke solution into two different sites of the left ventricular myocardium to determine changes, and their duration, resulting from volume effect. Five one-hundredths milliliter of whole blood, serum, or the supernatant of centrifuged blood coagula, as well as serotonin or histamine in 0.05-ml volume of Locke solution, was injected into the left ventricular wall. Care was taken to avoid damage to major arteries and veins. Two milliliters of 0.4 percent T-1824 (Evans' blue) in Locke solution were injected into the aortic cannula to facilitate macroscopic determination of the "infarct." Reserpine or chlorpromazine in amounts from 0.0001 to 1 μg/ml was added to the perfusion solution in the reservoir to determine their efficacy in preventing the effect of intramyocardially given serotonin or histamine. Serums obtained from centrifuged blood coagula (1 ml), histamine, serotonin, reserpine, and chlorpromazine in varying concentrations were injected into the aortic cannula. The effects of these agents on the functioning of the heart were kymographically recorded. Coronary flow was measured with Condon's magnet tipper. Reserpine and chlorpromazine were tested with respect to their effectiveness in altering the action of serum, histamine, and serotonin on the functioning of the heart and coronary flow.

Control experiments showed that insertion of a needle into the myocardium leaves a small opening through which minute amounts of perfusion fluid and dye escape. Small volumes of Locke solution or of whole blood injected into the ventricular wall did not interfere with the dye distribution; this fact could be established with the "intravital" staining technique.

Injection of 0.05 ml of serum (taken immediately after clot formation) into the same site prevented staining of the injected area for approximately 12 minutes, whereas serum obtained through centrifugation of a coagulum caused marked focal damage, which spread rapidly within the first 20 minutes and expanded more slowly during the following 2 hours.

Extent of the damaged area was made visible by injection of Evans' blue, which caused intense coloring of the entire myocardium, sparing only the "infarct." In each case, the "infarct" involved the entire thickness of the ventricular wall.

Injection of serotonin in amounts from 0.00000005 to 300 μg induced "infarcts," involving an area of about 1 cm in diameter, which were fully developed within 20 minutes and disappeared after 45 minutes.

Injections into the myocardium of 0.00000005 to 100 μg of histamine caused the gradual development of an "infarct," which reached its greatest extent at the end of 2 hours and was still detectable after 5 hours.

Reserpine added to the perfusion fluid in concentrations of 0.01 and 0.1 μg/ml did not significantly alter the serum- or serotonin-induced "infarct" formation and did not alter the histamine-induced "infarct" formation at all. In doses of 1 μg and more, it prevented 50 percent of "infarct" formation but at the same time markedly reduced the coronary flow.

Chlorpromazine, added to the perfusion fluid in concentrations of 0.001 μg/ml and higher, prevented "infarct" formation that otherwise followed intramyocardial injection of serum (0.1 ml), serotonin (300 μg), and histamine (100 μg). In lower concentrations, chlorpromazine did not give complete protection.

One milliliter of serum (obtained through centrifugation of blood coagula) injected into the aortic cannula did not significantly alter either the functioning of the heart or the coronary flow.

It was established that histamine (*5*) and serotonin (*6*), administered by way of the aortic cannula, have transient, strongly positive chronotropic and inotropic effects and that they increase the coronary flow by approximately 10 percent. The action of chlorpromazine and reserpine on the functioning of the heart and coronary flow are summarized and compared in Table 1.

The absence of extensive thrombosis and complete occlusion in a high percentage of myocardial infarct cases (*7*) suggested the possibility that some other factors—possibly of a chemical nature—are involved in the development of this pathology.

The foregoing study was based on the hypothesis that one or several chemical agents, liberated during the clotting process, may produce myocardial damage. Histamine and serotonin, both known to be released from certain disintegrating blood cells, were suspected of being such pathogenic agents.

To test this hypothesis, it was necessary to establish (i) whether myocardial damage could, indeed, be produced by endogenous chemicals in the absence of mechanical obstruction; (ii) whether such chemicals, in order to exert damaging effect, would have to act within the myocardium or within the coronary vessels; and (iii) whether a small blood clot would liberate such substances in quantities sufficient to become pathogenic.

The finding that chlorpromazine in very low dosage prevented the myocardiotoxic effect of serum, histamine, or serotonin suggested the possibility that chlorpromazine could be used as an adjuvant in prophylactic treatment of myocardial infarction.

Whether the results of the foregoing study constitute an exact parallelism to the conditions that prevail in myocardial infarction can be established only through quantitative determinations of histamine and serotonin in the infarcted areas of the human heart and through histopatho-

Table 1. Comparative effects of chlorpromazine and reserpine on perfused surviving rabbit heart.

Chlorpromazine dosage (μg)	Effect on functioning of heart	Effect on coronary flow	Reserpine dosage (μg)	Effect on functioning of heart	Effect on coronary flow
0.01	None	None	0.01	None	None
0.1	None	Slight*	0.1	None	Slight†
1	None	Increase	1	None	Slight
10	Slight negative chronotropic and inotropic	Increase	10	Slight negative chronotropic and inotropic	25-percent reduction
100	Toxic	Increase	100	Marked negative chronotropic and inotropic	60-percent reduction
500	Toxic	Slight†	500	Toxic	Coronary constrictors no longer effective in further reducing flow

* Increase. † Decrease.

logic comparison between spontaneously occurring and experimentally induced lesions (*8*).

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15 April 1957

Electrochemical Basis for a Contractile Mechanism and Some Related Cellular Phenomena

Most explanations of the contractile process in muscle have been based on models which assume that the imposition of a charge on some suitable side chain can effect a contraction or extension of the polypeptide backbone chain or can produce a structural alteration in one or more of the protein components (*1, 2*). It is perhaps worth while to point out that there exists an alternative electrochemical phenomenon which could produce a contraction by a relatively long-range field effect and which forms an attractive model for the explanation of many features of the contractile mechanism. Likewise, the essential characteristics of this phenomenon suggest it as a possible cause for other long-range effects in cellular behavior.

The principle of this model is analogous to that used recently by Kolin (*3*) to separate individual proteins from a mixture. Consider a macromolecular complex (such as actomyosin) which has one end, *b*, in an environment such that the *p*H is above the isoelectric point, *p*I, of the protein component in that region, and whose other terminus, *a*, is in an environment such that the *p*H is below the isoelectric point (Fig. 1). The protein at *b* will carry, therefore, a net negative charge, while that at *a* will be positively charged. Nevertheless, in these circumstances the two ends do not necessarily attract each other electrostatically, for counter-ions, indicated by charges within the squares of Fig. 1, would be gathered around each region. If, however, a suitable electric field is now imposed on this system, the fiber should contract (Fig. 1) as a result of the repulsive force of the negative end of the field on the top section of the macromolecule and of the positive pole on the bottom section of the macromolecule.

That this combination of a *p*H gradient and an electric field will produce motion of the protein molecules in the manner described is shown not only by Kolin's rapid, sharp separations of constituents from a mixture of molecules but also by a simple macroscopic experiment that was carried out in this laboratory. Small disks of gelatin (*p*I = 4.9) were soaked in an acid buffer (*p*H 2.6) and a basic buffer (*p*H 9.6), respectively. A shallow trough was cut into paraffin (as is indicated schematically in Fig. 2), a 25-percent solution of glycerol in distilled water was poured into the trough, and the acidified gelatin disk was floated at *a*, the alkaline one at *b*. On imposition of an electric field in the direction indicated, *a* moved toward the right, *b* toward the left. When the electrode polarities were reversed, the disks reversed their direction of motion. These movements are exactly what one would expect for a cationic macromolecule at *a* and an anionic one at *b*.

In muscle fibers, the geometric localization of the oxidative enzymes (*4*) and of ATP-ase activity (*2*) could provide the *p*H and electric field gradients. Likewise, in other cells, localization of metabolic activities in various regions could establish a combined *p*H and electric field which might effect other intracellular motions, such as those of the spindle. In a cell membrane, contractile (or extensile) effects of these combined fields could markedly affect permeability by the creation of "holes" in the surface structure as the protein macromolecules moved together (or apart).

It seems worth while, therefore, to consider in further detail the effects of a combined *p*H and electric field as the basis of various relatively long-range phenomena in cellular behavior.

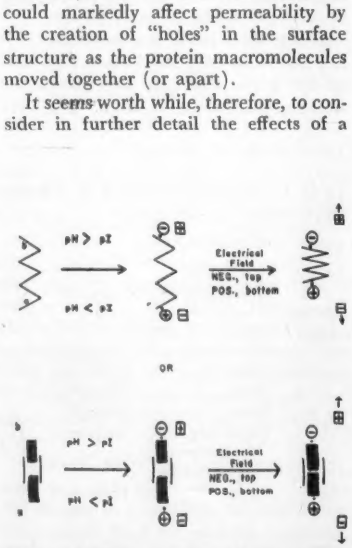

Fig. 1. Schematic diagram of contraction produced by establishment of *p*H gradient and electric field. Charges within circle represent those on protein; charges within squares represent counter-ions.

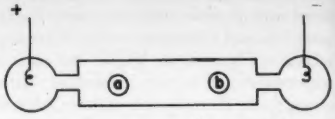

Fig. 2. Diagram of apparatus for moving gelatin disks. Disk *a* is equilibrated in acid buffer, and is therefore cationic. Disk *b* is equilibrated in basic buffer and is therefore anionic. Platinum-wire electrodes are immersed at the ends of the trough.

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15 April 1957

Atmospheric Carbon-14

According to Libby (*1*), most of the neutrons which escape into the surrounding atmosphere from an atomic or thermonuclear explosion interact with the nitrogen of the atmosphere to produce C^{14} through the nuclear reaction

$$N^{14} + n \rightarrow C^{14} + H^1$$

Because of the extensive use of C^{14} dating techniques, small additions of this material to the atmosphere may be important.

Libby (*1*) further estimates that, even to double temporarily the atmospheric radiocarbon content, megatons of fission of the order of 1000 would be required. With the measurement techniques now in use, it is possible to make measurements of the present equilibrium level of C^{14} in contemporary biological materials to an accuracy of approximately 1 percent. From these considerations it seems probable that only thermonuclear explosions will produce sufficient C^{14} to give measurable increases.

On the assumption that any C^{14} formed in weapons tests would be present in the air as CO_2 (*2*), collections of this gas from the atmosphere were begun in 1952. A vacuum pump was used to draw filtered air through a solution of sodium hydroxide (80 g of NaOH in 2 gal of water) at a flow rate of 10 to 12 lit/min.

At the end of the collection period, the solution contained 15 to 20 lit of CO_2 as Na_2CO_3, which was precipitated as $CaCO_3$ by the addition of $CaCl_2$. The precipitated calcium carbonate was separated by decantation and filtration, was dried, and was placed in sealed containers. By drawing the air through two collecting bottles in series, the efficiency of collection of CO_2 from the air was found to be approximately 80 percent.

The counting technique employed was that developed by Suess (*3*), in which the carbon-containing material is converted first to carbon dioxide and then to purified acetylene. The acetylene is used as the counting gas in a well-shielded proportional counter with an anticoincidence arrangement for reducing the cosmic-ray background. It was found that excellent stability and good repetitive accuracy could be obtained over periods of a year or more.

We were fortunate (*4*) in obtaining small quantities of strontium carbonate prepared from fossil carbon (lignite coal) and from contemporary carbon which had been measured previously (*5*). These samples were converted to acetylene and served as standards for all of our measurements. For each of the experimental values reported here, the counting rate of the atmospheric carbon was compared with two measurements on the contemporary carbon standard and with two measurements on the fossil carbon standard. One standard measurement was made within 3 days before, and the other within 3 days after, the sample count. In some cases, the reported values were derived from more than one measurement, and in other instances two completely separate samples were prepared from the same atmospheric carbon. All of the errors shown were computed from the total number of counts and are expressed as the 9/10 error in this quantity.

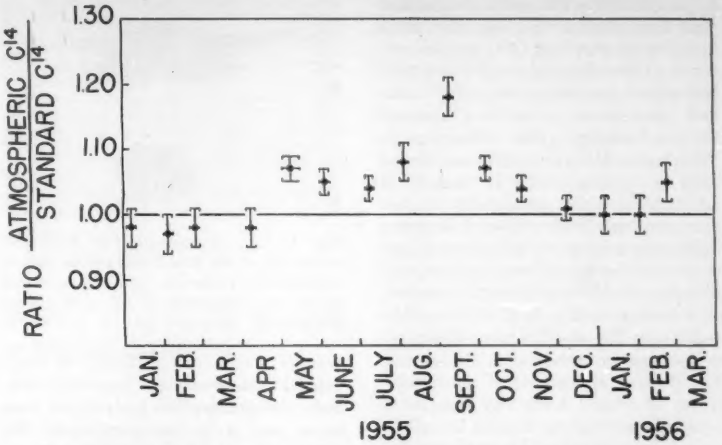

Fig. 2. C^{14} content of atmospheric CO_2 samples collected at Washington, D.C.

In order to test the reproducibility of the entire process, three simultaneous atmospheric carbon samples were collected and separately processed. The counting rates obtained were well within the expected statistical error.

By means of the afore-described techniques, four 1-week samples collected during the period from October to December 1952 in French Morocco and four similar collections in Alaska gave average values for the sample/standard ratio of 0.97 ± 0.01. Four samples collected at Washington, D.C., during this same period gave an average of 0.95 ± 0.01, while three collections made in the Hawaiian Islands and three in the Philippine Islands gave average sample/standard ratios of 1.00 ± 0.02. In no case did the C^{14} content of the atmospheric sample exceed that of the standard. The lower values (particularly at Washington, D.C.) are believed to reflect the dilution effect of the burning of fossil fuels.

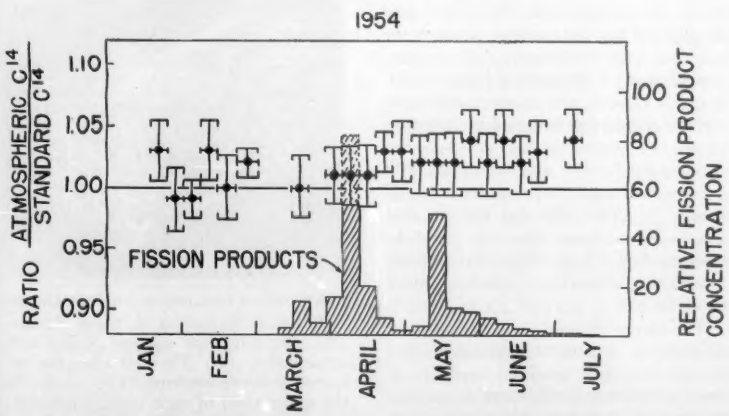

Fig. 1. C^{14} content of atmospheric CO_2 samples collected at Subic Bay, Philippine Islands.

We were able to obtain CO_2 collections from the Naval station at Subic Bay in the Philippine Islands during the thermonuclear tests of 1954. They are of interest, since it was possible to measure simultaneously the ground-level concentration of fission products. The direction of the winds below 20,000 feet from the Pacific proving grounds was such that the observed radioactivity should have been the result of low-altitude fission debris. The counting rates of atmospheric carbon, referred to standard carbon, for CO_2 samples that were collected from January to July of 1954 are illustrated in Fig. 1, along with the relative fission-product concentration for the same period. It is clear that the concentration of C^{14} did not increase as markedly as did that of the fission products. However, it does appear that it was somewhat higher after the tests than at the time of the 1952 collections. It is possible that most of the C^{14} which was formed was entrained in the hot gases of the fireball and injected into the stratosphere so that relatively little was present in the ground-level cloud.

In Fig. 2 are shown the relative atmospheric/standard carbon counting rates from collections made in Washington, D.C., from January 1955 to February 1956. Samples collected in the months of May through November 1955 were significantly higher than the standard in C^{14} content and, in one instance, as high as +18 percent. The fact that the concentration was at a minimum during the colder months may indicate a seasonal decrease, resulting from reduced plant transpiration and the burning of fossil fuels. Almost all of the measurements gave higher values than those of October–December 1952.

Previous measurements of atmospheric C^{14} by Kulp (*6*) indicated no significant deviation from contemporary wood for

12 samples collected under a variety of conditions. Rafter (7), on the other hand, found that four CO_2 samples collected in New Zealand in 1954 and 1955 had higher concentrations of C^{14} than had contemporary wood (+4.7 percent for one sample). Our collections at Washington, D.C., during the summer of 1955 gave values for the C^{14} content of atmospheric CO_2 appreciably higher than those previously reported. It seems difficult to account for these high values on the basis of isotopic fractionation, and therefore the increase in the C^{14} content of atmospheric CO_2 from 1952 to 1956 is probably the result of the addition of radiocarbon from thermonuclear sources. The delayed appearance of the C^{14} increase at ground level may indicate a stratospheric reservoir of this isotope.

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3 March 1957

Melanin Mobilization in Pigment Cells of the Mouse

Many lower vertebrates possess the ability to change color rapidly by effecting redistribution of pigment in the chromophores (*1*) of the skin. The pigment cells have been shown to be quite sensitive to a number of chemical and physical agents (*2*). Epinephrine causes a rather rapid migration of the cytoplasmic melanin granules to the center of the melanophore. Fig. 1*A* shows a melanophore on a fragment of fish fin in Holtfreter's solution. After the saline is replaced with 0.5 m*M* epinephrine in Holtfreter's solution, the pigment mass assumes the configuration of Fig. 1*B* within 30 seconds. If the epinephrine is removed, the pigment is redistributed throughout the cell.

It has been generally assumed that the ability to mobilize melanin is restricted to the pigment cells of only those animals that are capable of effecting rapid changes of skin color. Although no functional melanophores are found in mammals, the mammalian melanocyte does occur, and it is quite similar to the melanocytes of lower vertebrates, especially to those found in pigmented tumors (*3*). Since in earlier studies we had observed pigment mobilization in the tumor melanocytes of *Xiphophorin* fish melanomas (this has also been reported by Greenberg *et al.*, *4*), we suspected that such a phenomenon might also occur in the pigment cells of mammalian melanomas.

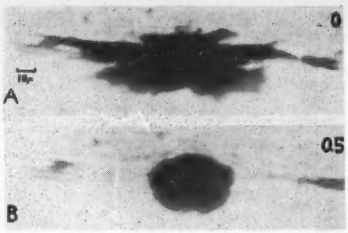

Fig. 1. (*A*) A melanophore from the caudal fin of the fish *Xiphophorus helleri* in Holtfreter's solution. (*B*) The same cell shown in *A* exposed to 0.5 m*M* epinephrine.

The mammalian melanocytes that we first studied were those found in tissue cultures of the Cloudman mouse melanoma (*5*). Melanocytes were abundant and rather easily distinguished from the larger macrophages and pigmentless cells. The nuclei of melanocytes were small and contained only one or two nucleoli, whereas other cell types had large, multinucleolated nuclei. Furthermore, melanocyte behavior, as observed in time-lapse motion pictures, was quite characteristic. Cell shape was ignored, since it tended to be variable.

Tissue cultures of the mouse melanoma were made according to the standard roller tube method (*6*). After about 1 week of culturing in horse serum medium (*7*), the cover-slip cultures were incorporated into a perfusion chamber (*8*). The perfusion medium used throughout the test was that in which the cultures had been grown. Since cytological changes in rounded cells are difficult to observe, the culture outgrowths were searched for flattened melanocytes of the type shown in Fig. 2*A*. A record of the subsequent testing was made with cinephotomicrographic time-lapse equipment (*9*). Color film was used so that the brown melanin granules could be distinguished from other cytoplasmic granulation, especially spherical mitochondria.

Time-lapse motion pictures made preliminary to treatment established that normal activities consisted typically of rapid membrane undulation, occasional pynocytosis (cell drinking), and considerable erratic motion of the melanin granules and mitochondria in the body of the cell. Such a cell in untreated medium is shown in Fig. 2*A*.

When the chamber medium was replaced with culture medium containing 0.5 m*M* epinephrine, normal membrane action was immediately suspended, the motion of the cytoplasmic granulation ceased, and all cell movement appeared to be frozen. Melanin granules clumped together, and the pigmented mass in the cytoplasm slowly began to contract. Some of the spherical mitochondria remained in the clear cytoplasmic regions (Fig. 2*B*), but their motion was halted by the treatment.

After the pigmented mass reached what appeared to be a maximum contraction (Fig. 2*B*), the chamber medium was replaced with untreated culture medium. Immediately the cell membrane

Fig. 2. (*A*) A melanocyte from the Cloudman mouse melanoma in tissue culture. (*B*) The same cell exposed to 0.5 m*M* epinephrine. (*C*) The cell after the removal of the epinephrine. The number in the upper right of each photograph indicates the time interval in minutes from the preceding picture.

resumed the normal rhythmic undulations, and melanin granules at the edge of the pigmented mass broke free into the cytoplasm and resumed erratic motion. The dimensions of the pigmented area gradually increased (Fig. 2*C*). Cinemagraphs taken for a considerable period of time after the treatment revealed no sign of cell damage.

Planimetering of the pigmented areas of the cell in Figs. 1*A* and 1*B* reveals that the fish cell is capable of reducing its pigmented region to about 50 percent of the original area. Similar measurements of Figs. 2*A* and 2*B* show a reduction to about 80 percent for the mouse cell.

Normal melanocytes found in cultures of the skin from the dorsal regions of 15-day-old mouse embryos were tested in the manner described, and the results appeared to be similar. No other mammalian species was tested.

Whether or not the cell herein described actually corresponds to a melanocyte or melanophore is largely a problem of definition. The presence of hair or fur coverings on mammals prevents such cells from fulfilling a functional role. We therefore recommend the retention of the term *melanocyte* for these cells and that they be distinguished from the melanophore of lower vertebrates on the basis of normal function, rather than on the ability to mobilize pigment.

This demonstration of a pigment mobilization system in mammalian melanocytes may provide a fresh approach to melanoma chemotherapy. The advantages are manifold: much information is available in this field (*2*, *10*), the effects of appropriate chemicals are highly selective and are produced at low concentrations, and the effects are produced within minutes of the drug application.

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25 March 1957

Behavior of the Dermal Mast Cells in Magnesium-Deficient Rats

A diet that contains not more than 1 to 2 ppm magnesium produces peripheral vasodilation in young rats, which appears after 4 days (*1*), is most intense after a week or 10 days, and then subsides gradually. Since the mast cells have recently been associated with the production of histamine (*2*, *3*), it seemed possible that they might be involved in the afore-mentioned syndrome.

Three groups of five rats of 40 g were fed a casein diet that contained less than 1 ppm of magnesium (*4*), for periods of 7, 14, and 28 days. An identical number of controls for each group were fed the same diet into which had been blended 0.6 g of magnesium sulfate per 100 g of diet. Portions of skin from the face and from the abdomen were fixed in formaldehyde-ethanol for maximal retention of mucopolysaccharides (*5*), cut at 10 μ in celloidin, and treated with diluted Wright stain to permit easy identification of the mast cells (Fig. 1), whose granules are azurophilic.

The cells were counted at a magnification of 264, which produced a field of 0.17 mm². The averages of cumulative counts (Table 1) have revealed a remarkable constancy between controls of the three groups as well as a constant difference of approximately 3 times between facial and abdominal skin. The magnesium-deficient animals produced comparable counts at 7 and 14 days. At 28 days, however, both abdominal and facial samples revealed a 40 to 50 percent difference in the mast-cell population as compared with controls.

In addition to the differences in mast-cell numbers, there were individual variations in shape and degree of granulation among individual cells. In all the animals, the mast cells were found to be most abundant and highly granular in the vicinity of the hair-bulbs (Fig. 1). Closer to the surface of the skin, the cells were less abundant; immediately under the epidermis, they appeared to have fewer granules (Fig. 1). In most of the animals that were fed the deficient diet for 7 days, this phenomenon was grossly exaggerated; the cells were poorly granulated over a wide area, and the cells located near the epidermal junction were practically empty of granules. The considerable variations in the shape of the cells seem to indicate accelerated ameboid activity. At 14 and 28 days, there appears to be progressively less degranulation and pleomorphism.

With an artificial histamine stimulator, Fawcett obtained degranulation accompanied by release of histamine (*3*, *6*). This was followed by rapid regeneration of granules and cells. In the experiments described in this report (*7*), hyperemia was proportional to dermal mast-cell count (Table 1). It is thus possible that the sudden deprivation of magnesium might act as a histamine stimulator.

On the other hand, the disappearance of granules and pleomorphism in the mast cells can be interpreted as passive

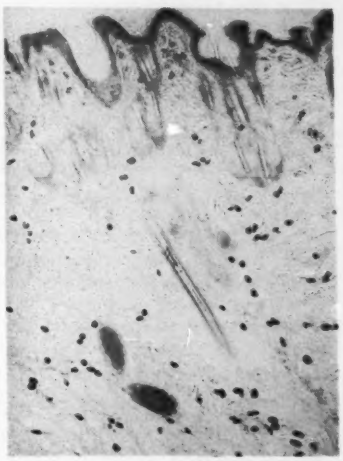

Fig. 1. Portion of the facial skin of a normal rat, stained with diluted Wright (×114). Mast cells in black.

Table 1. Mast-cell counts. C, control group; D, magnesium-deficient group; F, facial skin; A, abdominal skin; ± S, standard error.

Duration in days	Group and location	No. of animals	No. of microfields	Total cells counted	Avg. per field (± S)
7	C, A	2	22	247	11.2 ± 1.1
7	D, A	5	123	1351	11.0 ± 0.3
7	C, F	2	41	1385	33.8 ± 2.4
7	D, F	5	77	2214	28.8 ± 1.4
14	C, A	3	34	340	10.0 ± 0.6
14	D, A	5	60	667	11.1 ± 0.6
14	C, F	3	50	2150	43.0 ± 2.3
14	D, F	4	43	1507	35.1 ± 3.0
28	C, A	3	35	338	9.7 ± 0.5
28	D, A	2	36	138	3.8 ± 0.5
28	C, F	3	34	1180	34.7 ± 1.6
28	D, F	2	30	590	19.7 ± 1.4

breakdown or environmental modification that are the result of vasodilation and edema (*3*, *8*).

The next phase of the syndrome, during which blood magnesium returns to normal level (*9*), has shown blanching of the skin and regranulation of the mast cells. However, the dermal mast-cell population was only about one-half of that of the controls at 28 days (Table 1); this indicates a slow rate of regeneration consistent with that of mast-cell damage by osmotic environmental changes (*3*, *10*).

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4 April 1957

Gibberellin Effects on Temperature and Photoperiodic Requirements for Flowering of Some Plants

Several physiologic responses in plants that heretofore have not been subject to chemical regulation may be controlled by gibberellin. Dwarfism, both genetic (*1*) and physiologic (*2*), may be overcome, and growth rates characteristic of normal varieties may be established. The cold requirement for flowering of the biennial *Hyoscyamus niger* has been replaced by treatment with gibberellin (*3*), and encouraging results with other biennials and annuals have now been reported (*4*). In this report (*5*), the induction of flowering with gibberellin in a large number of genera and species that were grown under environmental conditions not conducive to flowering is described.

All plants were grown from seed and maintained in pot cultures of soil in the greenhouse during the summer, fall, and winter of 1956–57. Treatment was initiated when the plants were at a stage, defined by leaf number or by stem or root size, at which exposure to cold or to long days would have resulted in a prompt flowering response. Gibberellin was applied, either as droplets of water solution on the apices of the plants or as an aqueous spray, to the foliage. Further details of the treating procedure, with a listing of the biennials and long-day annuals which have flowered with gibberellin under noninductive environments, are given in Table 1.

The biennials that were induced to flower with gibberellin were grown at temperatures slightly higher than the critical temperature for flower formation. That these temperatures (10° to 13°C) were noninductive was indicated by the absence of flowering in controls. The original finding (*3*) for *Hyoscyamus niger* was no exception. At temperatures of 18°C or above, extensive stem elongation was induced in cabbage, kale, beets, rutabagas, turnips, and celery, but flowering was not consistent. In contrast, gibberellin has caused stem elongation and flowering in carrots over a wide range of noninductive temperatures (13° to 25°C) and under short (9 to 11 hours), as well as long (14 to 16 hours), photoperiods.

With long-day annuals, flowering was induced under a noninductive environment of a short (9 to 11 hours) photoperiod and low (10° to 13°C) temperature. Under the same conditions, but in the absence of gibberellin, lettuce, endive, radish, spinach, dill, and mustard remained vegetative and acaulous.

Development of most gibberellin-treated biennials and annuals during flowering differed from that of the nontreated plants. On nontreated plants, bolting and flower initiation occurred simultaneously, while treated plants developed stems from 20 to 100 cm higher before flower buds could be identified.

Regardless of whether the effects of gibberellin on flower formation are direct or indirect, it has now been established that treatment with gibberellin, a naturally occurring plant product, has resulted in complete flowering responses. Often a single application is sufficient to induce flowering in a wide variety of economic crops grown under nonflowering conditions of temperature (the cold-requiring biennials) and photoperiod (long-day-requiring annuals).

Table 1. Cold-requiring biennials and long-day annuals in which flowering has been induced by gibberellin. (Plants grown under noninductive conditions.)

Biennials		Long-day annuals	
Plant	Treatment	Plant	Treatment
Brassica oleracea var. *capitata* (cabbage). Golden acre and Ferry's round dutch	100 μg weekly for 8 wk. First treatment at stem diameter of 1 cm and 7–9 leaves	*Anethum graveolens* (dill)	1 foliage spray of 100 ppm at 5–6 leaf stage
Brassica oleracea var. *acephala* (kale). Siberian and Dwarf blue curled	(As above for cabbage)	*Brassica pekinensis* (Chinese cabbage). Michihli	2 foliage sprays (3-wk interval) of 1000 ppm at 6–7 leaf stage
Brassica oleracea var. *acephala* (collards). Georgia and Louisiana sweet	100 μg weekly for 6 wk at 7–9 leaf stage and 1 cm stem diameter	*Brassica juncea* (mustard). Southern giant curled and tendergreen	100 μg weekly for 3 wk at 8–10 leaf stage
Brassica Napobrassica (rutabaga). Purple top	3 foliage sprays of 1000 ppm at 2-wk intervals at the 6–9 leaf stage	*Cichorium endivia* (endive). Full heart Batavian and green curled	100 μg weekly for 8 wk at 8–10 leaf stage
Brassica Rapa (turnip). Purple top	(As above for rutabaga)	*Lactuca sativa* (lettuce). Great Lakes	3 applications (4-wk interval) of 20 μg at 8–10 leaf stage
Daucus Carota var. *sativa* (carrot). Chantenay and Imperator	20–100 μg/plant when roots were 1 cm or larger in diameter	Bibb	2 applications (4-wk interval) of 20 μg at 8–10 leaf stage
Digitalis purpurea (foxglove)	100 μg/plant for 6 weeks at the 6–8 leaf stage or 1000 ppm foliage spray	Grand Rapids and Tendergreen	20 μg at 8–10 leaf stage
Bellis perennis (English daisy)	(As above for foxglove)	*Raphanus sativus* (radish). Crimson giant and Icicle	100 μg or foliage spray of 100 to 1000 ppm at 3–5 leaf stage
Matthiola incana (stock)	20–100 μg/plant at the 6–8 leaf stage or a foliage spray of 100 ppm	*Spinacia oleracea* (spinach). Prickly dark seeded	Foliage spray of 1000 ppm at 2–3 leaf stage, repeated after 4 wk
Viola tricolor (pansy)	(As above for stock)	*Petunia hybrida* (petunia)	Foliage spray of 10–100 ppm at 4–8 leaf stage

All cold-requiring biennials, when grown close to, but slightly higher than, the known inductive temperatures, have been induced to flower with gibberellin. Similarly, long-day plants, after treatment, have flowered under short photoperiods. Exceptions have not thus far been observed. Widespread usefulness of such findings will be realized in earlier flowering for seed production and in the commercial culture of many flowering annuals and biennials.

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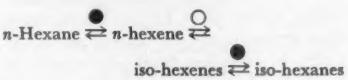
10 April 1957

Stepwise Reaction on Separate Catalytic Centers: Isomerization of Saturated Hydrocarbons

In heterogeneous catalysis, a chemical reaction may proceed by creation of an intermediate product on one type of catalytic center, creating a "true"—that is, existing independently in the desorbed state—intermediate at low concentration, which is then further reacted by another type of and physically distinct catalytic center. In a previous report (*1*), it was shown how physical transport processes lead to a general criterion for required physical proximity between the two types of catalytic materials, depending on the maximum attainable vapor pressure of the intermediate.

The experimental results reported in this article present evidence that this type of mechanism is operative in the catalytic isomerization of paraffin hydrocarbons by acidic solids (for example, aluminum silicates, or halogenated alumina) impregnated with small amounts of group VIII metals (*2*).

Reaction mechanisms proposed by Mills *et al.* (*3*) have included formation of intermediate olefinic species and surface migration between metal and acidic sites. Our results confirm the hypothesis of olefinic intermediates. They furthermore demonstrate (i), their existence as a true intermediate existing in the gas phase; (ii) the ability of metal and acidic sites to act as independent, physically distinct catalysts; and (iii) the role of ordinary gas-phase diffusion of intermediates between the consecutive reaction sites in supporting the over-all reaction rate, in quantitative agreement with the criterion developed in the previous report (*1*). Specifically, the four sets of experimental results reported here support a mechanism by which the isomerization of *n*-hexane over platinum-containing silica-alumina catalyst proceeds by the mechanism



where the hexenes are true, low-concentration gas-phase intermediates traveling by diffusion between independent Pt (●) and "acidic" catalyst sites (○).

At 373°C, thermodynamic data (*4*) show that the thermodynamically attainable relative concentration of hexenes in *n*-hexane at 1 atm hydrogen partial pressure is 0.6×10^{-2} if all *n*-hexene isomers are produced, or 3×10^{-2} if, in addition, all methyl-pentene isomers are formed. We have passed 11 g of *n*-hexane per hour over platinum catalyst at 373°C, at 5/1 hydrogen-hexane molar ratio and at atmospheric pressure and have found, by mass-spectrometric means, the concentration of C_6 olefins produced to be 2.7×10^{-2}. This magnitude is in agreement with that attainable at thermodynamic equilibrium.

High activity of acidic oxide catalysts such as aluminum silicates to catalyze the isomerization of olefins has been reported (*5*). Over silica-alumina catalyst (422 m²/g surface area, 11 percent by weight Al_2O_3), we have obtained 43 percent conversion of *n*-hexene to iso-hexenes at a space rate of 2.6 cm³ of liquid hexene per hour, per cubic centimeter of catalyst space and at a temperature as low as 300°C.

The ability to feed the olefin isomerization reaction on the silica-alumina (Si/Al) catalyst particles from the low-concentration pool of olefins produced by supported platinum in the same reactor space was tested by observing iso-hexane production in a reactor filled with (i) inert-supported platinum, (ii) particles of silica-alumina, and (iii) a mechanical mixture of inert-supported platinum and particles of silica-alumina, both of 0.84- to 1.4-mm particle size.

Table 1. Cooperative action of independent Pt and acidic particles (hexane feed-rate, 26 cm³/hr).

Charge in reactor	*T* (°C)	Conversion to iso-hexane (% wt.)
i 4.7 g Pt/silica (10 cm³)	373	0.9
ii 7.0 g Si/Al (10 cm³)	373	0.3
iii Mixture of i and ii (10 cm³ of each)	373	6.8
i 4.4 g Pt/carbon (10 cm³)	448	1.5
ii 7.0 g Si/Al (10 cm³)	448	0.9
iii Mixture of i and ii (10 cm³ of each)	448	6.4

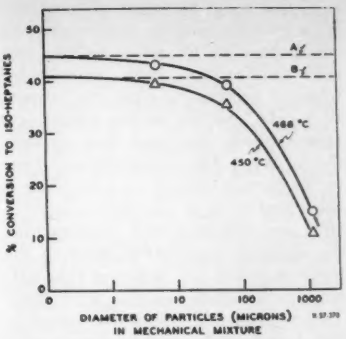


Fig. 1. Isomerization of *n*-heptane over mixtures of particles of silica-alumina and particles of inert-supported platinum. Conversions *A* (468°C) and *B* (450°C) are those obtained over platinum-impregnated silica-alumina.

Experiments were carried out using a feed rate of 26 cm³ per hour of *n*-hexane and of hydrogen in a 5/1 molar ratio at atmospheric pressure. Results for the weight-percentage conversion to iso-hexanes in two typical experiments are shown in Table 1. The successful interaction of the two catalyst components by way of gas-phase intermediates to achieve hexane isomerization is apparent from these results.

If the entire reaction rate is thus supported by gas-phase intermediates, the criterion for a critical particle size to obtain maximum conversion will apply, as developed in the previous report (*1*). This was tested in a series of experiments with elevated hydrogen pressure, where side reactions were suppressed; this resulted in substantially clean paraffin isomerization. *n*-Heptane was passed at a space rate of 0.7 g per hour, per gram of catalyst, with hydrogen in 4/1 molar ratio, at 25 atm total pressure.

The conversion to iso-heptanes was determined by mass spectrometer analyses, when, as catalysts, mechanical mixtures of equal weights of Pt-impregnated carriers (approx. 0.3 percent by weight Pt on total mixture) and of silica-alumina (141 m²/g surface area, 11 percent Al_2O_3) were charged to the reactor. For the 1100-μ size, a loose mixture of the component particles was charged. For the two smaller sizes, the component mixture was compressed into ⅛- by ⅛-in. cylindrical pellets. For compari-

son—that is, for maximum physical intimacy between catalytic components—an acidic base of 69 m^2/g surface area silica-alumina was used, *impregnated* with 0.2 percent Pt. Thus, the amount of "acidic" surface in the reactor was approximately the same here as with the mixtures. The thermodynamic limit to the partial pressure of *n*-heptenes is calculated to be of the order of 10^{-2} to 10^{-3} atm. For maximum reaction rate, the diffusion criterion discussed in the previous report (*1*) indicates that particle size should be less than about 100μ. The experimental results are shown in Fig. 1 and are in good agreement with this prediction, based on reaction via gas-phase olefin molecules which travel by ordinary diffusion between the two distinct types of catalytic sites.

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4 April 1957

Infective Transfer of Maternally Inherited Abnormal Sex-Ratio in Drosophila willistoni

Deviations from the normal 1/1 ratio of sexes are known in natural populations of several species of *Drosophila*. These deviations usually take the form of production of unisexual progenies which consist mainly or exclusively of daughters. In *D. obscura, D. pseudoobscura, D. persimilis,* and *D. azteca,* this condition is inherited through the X-chromosome (*1*). On the other hand, Cavalcanti (*2*), Magni (*3*), and Carson (*4*) discovered in *D. prosaltans, D. bifasciata,* and *D. borealis,* respectively, deviations from the normal sex-ratio which appear to be inherited through the cytoplasm. Females of certain strains produce progenies that consist mainly or only of daughters, regardless of which males they are crossed to, and this condition is transmitted, in turn, to all of their female offspring. This cytoplasmically inherited "sex-ratio" condition resembles, in many ways, the oversensitivity to CO_2 that was studied by l'Heritier and his school (*5*). Recently, B. Spassky observed that a single female of *D. willistoni,* from Jamaica, and a single female of *D. paulistorum,* from Sierra Nevada de Santa Marta, Colombia, produced nearly unisexual female progenies and that this peculiarity was inherited by their offspring. Spassky has very generously given these stocks to one of us (C.M.) for study.

The "sex-ratio" condition of *D. willistoni* has been examined in some detail. Females from the "sex-ratio" strain produce nothing but daughters in outcrosses to males from most of the strains which have been tested in this respect. However, outcrosses to males from three strains collected at Recife, Brazil, from one strain from the island of Saint Lucia, West Indies, from one strain from Costa Rica, and from a laboratory strain that contains the second chromosome mutants Star, Hooked, abbreviated, and brown, produce intermediate or normal (1♀/1♂) sex-ratios after one or more generations of crossing and backcrossing. Thus, the "sex-ratio" condition is not transmitted through the usual chromosomal inheritance, but it is not independent of chromosomal genes (*6*).

Eggs deposited by "sex-ratio" females fall into two readily distinguishable classes when they are dechorionated about 2 to 4 hours after deposition. Approximately half of the eggs begin to show translucent areas, both anteriorly and posteriorly, following formation of the blastoderm. These eggs show no further normal development and yield no larvae. Presumably, they represent dying male zygotes. A fraction of eggs which appear normal in early stages produce embryos which fail to hatch and darken markedly between 24 and 36 hours after being laid. Although the sex of these embryos is not yet certain, it seems probable that they are female.

To test the possibility of the transfer of the "sex-ratio" condition to normal females, early abnormal eggs from "sex-ratio" females were punctured (about 3 to 6 hours after deposition) with a micropipette. Ooplasm was taken into the pipette and injected into the abdomens of young virgin females from the Recife strain. Uninjected females from this strain give, with great regularity, a normal 1/1 ratio of the sexes. The injected females were then mated to males of their own strain and transferred, at 2-day intervals, to a fresh culture medium. Eggs were collected in this way until the end of the life of each of the injected females. In most of the cases the broods from each of the females for the first 2 weeks of egg production yielded normal proportions of males and females. However, at the end of this period, five out of the 16 females began to produce mainly daughters, and finally they produced daughters exclusively. One of the females showed a ratio of 2♀/1♂ from the beginning and, at the end of the first 2 weeks, began to produce only females. Daughters of the injected females derived from the successive broods of eggs were then tested by mating to brothers or to males from the normal Recife strain. In the two most thoroughly tested cases of broods from the later period, when only females were being produced, 17 daughters of one injected female all showed "sex-ratio" in their progeny, 11 giving no males at all; the others, only a few males. Twelve daughters of the other injected female all gave "sex-ratio" progeny; among them were five that gave no males at all. In all cases the progenies were sufficiently large to leave no doubt of the presence of the "sex-ratio" condition in these flies. Subsequently, the F_2 daughters have produced "sex-ratio" progenies; hence, it is clear that the original infection has now been transmitted through three generations. Stocks of these new "sex-ratio" strains are now being maintained.

Examination of the eggs of the new "sex-ratio" females shows the same abnormalities that were encountered in the original "sex-ratio" strain of Jamaican origin (*7*).

A series of controls was carried out, along with the "sex-ratio" injections. For these, ooplasm of unfertilized 3- to 6-hour eggs from virgin females of the Recife strain was injected into young virgin females of this strain, by means of the same procedures that were followed in the experimental series. Broods from eggs laid at 2-day intervals were raised, and the sex ratio was determined. In none of the 15 females of this control were there any significant deviations from the normal ratio of 1/1, even after the 2-week period in which the experimental series showed the striking changes that have been described in this report.

It is therefore clearly demonstrated that the "sex-ratio" condition in *Drosophila willistoni* can be transferred to normal females, and that it is essentially infectious in nature.

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22 April 1957

Book Reviews

pH Measurements, Their Theory and Practice. Victor Gold. Methuen, London; Wiley, New York, 1956. 125 pp. $2.25.

According to the foreword, this little book is "intended for non-specialists, and its object is not only to describe the basic experimental techniques for the measurement of *p*H, but also to help towards a better understanding of the correct significance of the measurements and the limitations of the concept of *p*H." A detailed description of experimental procedures was not possible in the limited space at the author's disposal. The second purpose is, however, admirably fulfilled.

The practical *p*H scale is a compromise between the desire to retain a well-established, convenient experimental method and the desire to allow some theoretical significance to be attached to the results. The lack of exact fundamental meaning is the cause of most of the dissatisfaction with the modern scale. It is hoped that the sections on interpretation of *p*H measurements in aqueous solutions and in mixed solvents will help to dispel the widespread confusion and misunderstanding that have surrounded this subject in the past. They are written with clarity and capability.

In my opinion, however, the author has emphasized a difference between American and British standard practice that does not exist. It is true that the National Bureau of Standards has chosen $-\log [H^+]f_{H^+}$ as the formal definition of the standard value (pH_S), whereas the British standard regards this unit as $-\log [H^+]f_{\pm(1:1)}$. However, the convention on which all of the numerical values of pH_S are based identifies f_{H^+} with $f_{\pm(1:1)}$ for a "typical" strong electrolyte. The author states (page 39): "Although these two points of view appear to be quite different, they do, in fact, lead to the adoption of the same value for the *p*H of the 0.05*M* solution of potassium hydrogen phthalate." This could hardly be otherwise, for both standard methods adopt the numerical values assigned to this buffer solution by Hamer, Pinching, and Acree.

In a little more than 100 pages, this book covers a remarkable amount of material. The nine chapters include a treatment of the theory and role of *p*H in proton-transfer equilibria and in kinetics, theory of galvanic cells, electromotive force and optical measurements, and definitions and interpretation of *p*H in aqueous and nonaqueous media.

In spite of its wide scope, the discussion is rigorous and unmarred by oversimplification, except possibly in the omission of the important effect of indicator charge type on the *p*H measurement by optical means. The index of mathematical symbols is a worthy feature. References to the literature are few in number and generally inadequate. Nevertheless, this volume speaks with competence and authority and should prove useful to student and research worker alike.

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Allgemeine Meereskunde. Eine Einführung in die Ozeanographie. Günter Dietrich and Kurt Kalle. Borntraeger, Berlin, 1957. 492 pp. Illus. DM. 56.

The publication of a new professional book in their field is always a major event for oceanographers. Despite the recent deluge of popular books about the sea, there have been few scholarly attempts since publication of *The Oceans,* 15 years ago, to summarize the present status of fact and theory in marine science. No post-World War II textbook has been designed to replace *The Oceans,* since none attempts so broad a treatment. Instead, there have been numerous specialized discussions of the various individual branches of oceanography. Thus, marine geology has been discussed in Shepard's *Submarine Geology* and Kuenen's *Marine Geology*; marine chemistry, in Kalle's *Der Stoffhaushalt des Meeres* and Harvey's *The Chemistry and Fertility of Sea Waters*; physical oceanography, in Proudman's *Dynamical Oceanography* and Shuleikin's *Fizika Moria*; and marine biology in a number of books, including Hardy's *The Open Sea,* Marshall's *Aspects of Deep Sea Biology,* and Zenkevich's *Fauna i Biologicheskaia Produktivnost' Moria.*

Allgemeine Meereskunde represents a return to the more general treatment. Indeed, the general arrangement of topics is very reminiscent of *The Oceans,* although biological and geological problems are given less emphasis.

The major topics discussed are the geomorphology of the sea floor, physical and chemical properties of sea water, oceanographic instruments and methods of measurement, heat budget, distribution of temperature, salinity and density, geochemistry and biochemistry of the ocean, theory of ocean currents, surface and internal waves, tides, and regional oceanography. In each section the organization is highly systematic, making the book easy to use as a reference. Although the treatment of most topics is traditional, many results of research published prior to 1955 have been included. The selection of examples leans heavily on the works of the authors and their associates, but the examples are always pertinent and instructive.

The long section on chemical processes was written by Kalle, and I believe that it is the best summary of chemical oceanography available today. The section on regional oceanography is one of the first attempts since *The Oceans* to summarize the present knowledge of the circulation and distribution of properties in the world ocean. Although I am distressed by the omission of Montgomery's isentropic analysis in favor of the *Kernschicht* method of Wüst and Defant and by the inclusion of an outdated interpretation of the meridional circulation in the equatorial Pacific, I feel that the general treatment is both instructive and provocative.

The field of oceanography has so broadened during the last 15 years that it is increasingly difficult to compress its basic facts and ideas within the covers of a single, convenient volume. This well-printed and clearly written book is, in many ways, the best general oceanographic textbook available today. It serves as another reminder that the oceanographer must have a command of German (as well as of Russian) to keep up with the latest developments in his field.

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Heterocylic Compounds. vol. 6, *Six-Membered Heterocycles Containing Two Hetero Atoms and Their Benzoderivatives.* Robert C. Elderfield, Ed. Wiley, New York, 1957. 753 pp. $20.

This sixth volume of *Heterocyclic Compounds* has 14 chapters which summarize the chemistry of certain six-membered heterocyclic ring systems. The scope of the material is shown by the following specific chapters: "Monocyclic dioxanes" (59 pages) by C. B. Kremer

and L. K. Rothen; "Benzodioxanes" (16 pages) by R. C. Elderfield; "Sulfur analogs of dioxanes" (26 pages) by R. C. Elderfield; "Pyridazines" (35 pages) by T. L. Jacobs; "Cinnolines" (40 pages) by T. L. Jacobs; "Phthalazines" (48 pages) by R. C. Elderfield and S. L. Wythe; "Pyrimidines" (70 pages) by G. W. Kenner and A. Todd; "Quinazolines" (53 pages) by T. A. Williamson; "Pyrazines and piperazines" (78 pages) by Y. T. Pratt; "Quinoxalines" (41 pages) by Y. T. Pratt; "Monocyclic oxazines" (68 pages) by N. H. Cromwell; "Benzoxazines" (37 pages) by R. C. Elderfield, W. H. Todd, and S. Gerber; "Thiazines and benzothiazines" (23 pages) by R. C. Elderfield and E. E. Harris; and "Phenazines, phenoxazines, and phenothiazines" (103 pages) by D. E. Pearson.

Each heterocycle is treated systematically; nomenclature, numbering, syntheses, and reactions are given. The literature is covered very well. The citations have been selected with care and attention to their importance. The chapters are well written, and the selection of authors is excellent. To assist the reader, each chapter has a complete table of contents, and a good index is provided.

This treatise is a great timesaver for all research chemists in the fields of organic chemistry and biochemistry. Parts of it will be of value to scientists in the fields of chemotherapy and pharmacology, since the authors have mentioned biological activity of important compounds. The book is well printed and edited.

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Water for Industry. A symposium presented 29 Dec. 1953 at the Boston meeting of the American Association for the Advancement of Science. AAAS publ. No. 45. Jack B. Graham and Meredith F. Burrill, Eds. Washington, D.C., 1956. 131 pp. Illus. $3.25, members; $3.75, nonmembers.

This timely little symposium volume contains nine papers by 12 authors who are experts on many of the broader problems of water and water supply. The volume does not cover the complete field of "water for industry," but the included papers fairly sample the kinds of water problems that are confronting industry now and those that are sure to arise in the future. These problems are much broader than those of industry alone. The whole field of water use is involved, because industrial water problems directly or indirectly affect all phases of our national economy. Here are a few of the more significant points made in the symposium papers.

The rapidly closing gap between water supply and demand in many places and the conflicts of interest in water supplies between states, between individuals, and between whole groups of users are forcing increased attention to water supply and water conservation on the part of Government agencies at all levels and of private organizations and citizens' groups. For example, optimum ultimate development of all recoverable water in the United States will be necessary for the national welfare, including national defense. Realistic forecasts of future urban and industrial developments, area by area, must be developed, and water must be reserved or otherwise provided for their supply. The market for farm products is not growing rapidly. Hence, wholesale expansion of agriculture is not the way to expand the national economy. Many thousands of people are drawn yearly from agricultural areas by employment opportunities in industrial centers. Some western areas are promoting local industrial development for purposes of diversifying their economy and holding their population. Many agricultural regions, however, are the very areas which are short of water or have low ceilings on their supplies. In some instances, practically all the water is committed for existing uses, chiefly agricultural. How, then, to supply industry?

Already the economy of certain industrial areas is precarious because of agricultural domination. Lack of planning for industrial and urban development 10 to 50 years hence is one of the greatest deficiencies in river-basin planning. Estimates have been made of urban and industrial requirements up to the year 1975. However, most of these are on a nation-wide or large-region scale and are not tied to specific areas or to river basins. They should be.

In the present stage of our development, water is a compelling influence in all our activities; within the near future it may become a controlling factor. Our national history is the history of a Horatio Alger among nations. We may yet face disaster if we fail to use the knowledge and skill that are now available to provide for optimum harnessing of this prime natural resource, water.

Several papers in the symposium merit special attention. The first, on "The available water supply," was prepared by C. G. Paulsen, retired chief hydraulic engineer, U.S. Geological Survey. In somewhat philosophic vein it analyzes and gives examples of the nation-wide water situation, the causes of varied water problems, and various approaches to their solution, thus establishing an appropriate background for succeeding papers on more specific topics.

Francis A. Pitkin's "Correction of a fluviatile delinquent: the Schuylkill River" is a dramatic historical sketch of the abuse of a watershed by mining, the 200-year deterioration of the watershed and the river, and their recent rehabilitation. One can only comment that man, not the river, was delinquent.

J. R. Whittaker's paper on "Water in the future" is outstanding and is probably one of the best recently published summaries, in simple, everyday language, of present and foreseeable water problems in the United States. The paper also sounds several encouraging notes of optimism. If intelligent planning is done and vigorous action is taken, the next generation may be spared a national problem. Too many problems have already been bequeathed to posterity.

This volume deserves wide reading and study. The analyses of the water problems are scientifically sound but are couched in readily understood, straightforward language.

R. L. NACE
U.S. Geological Survey

Advances in Virus Research. vol. IV. Kenneth M. Smith and Max A. Lauffer, Eds. Academic Press, New York, 1957. 339 pp. $8.

As in previous volumes of this series, the nine articles that comprise volume IV deal with various aspects of virology at a basic level, with considerable emphasis on information derived from application of the methods of physics and chemistry. It is not surprising, therefore, that three of the articles are concerned with plant viruses and two, mainly with bacteriophage, because the nature of these agents has allowed more precise physicochemical studies of the host-virus system in these cases than is possible for other viruses. Two of the articles deal entirely with animal viruses, and two others, with general subjects.

One of the latter, "Factors in virus evolution," by C. H. Andrewes, is a unique attempt to visualize, from accumulated information, the ways in which viruses may have evolved and in which they continue to adapt themselves to changes in their host populations. The question of an arthropod origin of many of the known viruses is raised, and the evidence is examined. Obviously, much of the material presented is highly speculative, but it is based on broad knowledge and experience and contributes to an area that has been largely neglected, that of orienting the viruses in the field of biology as a whole.

Andrewes includes in his discussion the selective effects of the immune state in host populations. An expansion of this theme is included in the article by Keith E. Jensen, "The nature of sero-

logical relationships among influenza viruses." Following a description of the antigens that are demonstrable in influenza-infected tissue, there is an account of the complex immunologic relationships, including the sequence of changes in dominant antigens, found among the numerous strains of influenza virus isolated during the last 25 years. Implications of this situation with respect to a successful method of vaccination are reviewed.

"Bacteriophages as genetic and biochemical systems," by A. D. Hershey, is a scholarly discussion of a complex area of study and contains a wealth of information. It is especially valuable in pointing out gaps in our knowledge and suggesting approaches to further problems. As is indicated by the author, the bacteriophage-host cell system has become a formal, as well as a biochemical, branch of genetics, and he ventures the opinion that this is one of the directions in which virology as a whole will have to advance.

"Attachment and penetration of cells by viruses," by L. J. Tolmach, is based almost entirely on studies with bacteriophage and draws heavily on the valuable contributions made by the Colorado group of which the author is a member. Much is now known, and included here, concerning the chemical nature of the processes discussed, and the kinetics and thermodynamics involved. Because of the tendency of the uninitiated to generalize about viruses as if they were a *bona fide* taxonomic group (Andrewes has something to say on this), it is unfortunate that the title does not indicate the restricted scope of the article and does imply a generalization. The essay concludes with an account of selected experiments from our meager store of information on similar activities of animal viruses. It is clear from both Hershey's and Tolmach's articles that the bacteriophage-host cell system is a special case and that generalizations from it should be strictly limited. It is also clear that the bacteriophage work has been invaluable in pointing the way to study of the intimate relationships between other viruses and their host cells.

Methods are described in considerable detail in "Particle counts and infectivity titrations for animal viruses," by Alick Isaacs. His discussion goes beyond an account of methods, however, and includes questions such as whether infections are initiated by single particles and what the significance of incomplete virus and virus filaments is. Parallel, in part, to Isaac's article is "Mechanical transmission of plant viruses," by C. E. Yarwood. It contains detailed information on the various factors of environment, donor and host plant, adjuvants, and so forth, that affect experimental transmission of plant viruses and thereby influence quantitative experiments.

Further information in one area of this field is given in "Effects of changing temperature on plant virus diseases," by B. Kassanis. It includes effects on susceptibility, incubation period, symptoms, and virus multiplication. The last is analyzed at some length, and a number of intriguing questions are raised concerning the dynamics of plant virus production and degradation. Examples of the value of heat for ridding plants of virus infection are described, and a tabulation of reports on this subject is included.

In "The anatomy of tobacco mosaic virus," N. W. Pirie is critical of the generally held concept, derived from physicochemical studies, that the virus particle possesses constant dimensions and composition. He discusses isolation of the virus substance and brings information in this field up to date. He stresses, as he has in previous writing, the differences found in the product that result from the use of different host plants, conditions of growth, and methods of preparation. This meaty essay is seasoned with an occasional salty comment.

In "Effects of non-ionizing radiations on viruses," A. Kleczkowski first briefly describes the physical aspects of non-ionizing radiations. His discussion of their effects on plant, animal, and bacterial viruses provides a valuable source of information in this field of study.

Each article begins with an outline of its contents and ends with its own list of references, arranged alphabetically. Three of the articles are accompanied by glossaries. Indexes of authors and subjects increase the value of these volumes as reference works. In addition to its usefulness to virologists, this book will be of value to other biologists, especially those whose interest is at the cellular level.

FRANCIS B. GORDON
Naval Medical Research Institute

New Books

Principles of Microbiology. Charles F. Carter and Alice L. Smith. Mosby, St. Louis, ed. 3, 1957. 665 pp. $5.

The Infectious Diseases of Domestic Animals. With special reference to etiology, diagnosis, and biologic therapy. William A. Hagan and Dorsey W. Bruner. Comstock Div., Cornell University Press, Ithaca, N.Y., ed. 3, 1957. 988 pp. $10.50.

Magnetic Removal of Foreign Bodies. The use of the alnico magnet in the recovery of foreign bodies from the air passages, the esophagus, stomach and duodenum. Murdock Equen. Thomas, Springfield, Ill., 1957. 101 pp. $4.50.

Plant Classification. Lyman Benson. Heath, Boston, 1957. 702 pp. $9.

Organic Chemistry. H. Harry Szmant. Prentice-Hall, Englewood Cliffs, N.J., 1957. 815 pp. $7.95.

Concepts of Force. A study in the foundations of dynamics. Max Jammer. Harvard University Press, Cambridge, Mass., 1957. 277 pp. $5.50.

Mathematics and Statistics for Use in Pharmacy, Biology and Chemistry. L. Saunders and R. Fleming. Published under the direction of the Council of The Pharmaceutical Society of Great Britain. Pharmaceutical Press, London, 1957. 267 pp. 27s. 6d.

College Chemistry. William H. Nebergall and Frederic C. Schmidt. Heath, Boston, 1957. 796 pp. $6.75.

Techniques of Guidance. Arthur E. Traxler. Harper, New York, rev. ed., 1957. 387 pp.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

Irvington House Conference on the Rheumatic Child and His World. 13 November 1956. Irvington House, New York, 1957. 68 pp.

A Revision of the East African Nasutitermitinae (Isoptera). Bulletin of The British Museum (Natural History), Entomology, vol. 5, No. 1. W. A. Sands. 29 pp. 10s. *On Spelaeogriphus, a New Cabernicolous Crustacean from South Africa.* Bulletin, Zoology, vol. 5, No. 2. Isabella Gordon. 19 pp. 6s. *Expedition to South West Arabia 1937–8.* vol. 1, Nos. 27–33. 79 pp. £1. *Fossil Mammals of Africa.* No. 12. *A New Miocene Rodent from East Africa.* D. G. MacInnes. 36 pp. £1. *Fossil Mammals of Africa.* No. 13. *Insectivora and Chiroptera from the Miocene Rocks of Kenya Colony.* P. M. Butler and A. Tindell Hopwood. 35 pp. 15s. *The Cracherode Shell Collection.* Bulletin, Historical Series, vol. 1, No. 4. Guy L. Wilkins. 64 pp. 21s. The British Museum (Natural History), London, 1957.

Second Tissue Homotransplantation Conference. Annals of the New York Academy of Sciences, vol. 64, art 5. 339 pp. $4.50. *Mercury and Its Compounds.* vol. 65, art 5. 295 pp. $3.50. *The Pharmacology of Psychotomimetic and Psychotherapeutic Drugs.* vol. 66, art 3. 424 pp. $5. *Anesthesiology and Related Problems.* vol. 66, art. 4. 182 pp. $4. Otto v. St. Whitelock, Ed. New York Academy of Sciences, New York, 1957.

California Wasps of the Genus Oxybelus (Hymenoptera: Sphecidae, Crabroninae). Bulletin of the California Insect Survey, vol. 4, No. 4. Richard M. Bohart and Evert I. Schlinger. University of California Press, Berkeley, 1957. 40 pp. $0.75.

Multichannel Pulse Height Analyzers. Proceedings of and informal conference at Gatlinburg, Tennessee, 26–28 September 1956. Nuclear Science Ser. Rept. No. 20. Publ. No. 467. H. W. Koch and R. W. Johnson, Eds. National Academy of Sciences–National Research Council, Washington 25, 1957. 205 pp. $2.

Meetings and Societies

National Science Teachers

The fifth annual convention of the National Science Teachers Association, an affiliate of the AAAS and a department of the National Education Association, was held in Cleveland, Ohio, 20–23 Mar. The theme for the sessions was "New frontiers for science teachers." Each day of the convention brought into focus a different facet of this general theme.

On 20 Mar. attention was centered on "Frontiers in national security." The keynote speaker was Arthur S. Flemming (U.S. Office of Defense Mobilization). "Science and the social frontiers" was the theme for the second day's sessions. I. Bernard Cohen (Harvard University) spoke on "The impact of science on society."

The third day of the convention had as its theme "Frontiers in scientific research." The main feature of this day's general session was a symposium, with presentations by Dennis Flanagan (*Scientific American*), Paul B. Sears (Yale University), and Elmer Hutchisson (Case Institute of Technology). Each of these speakers contributed his viewpoint on new developments in scientific thinking and their implications for science teaching. This was followed by a panel discussion and by questions from the floor. Members of the panel represented science teaching at levels of elementary, secondary, and higher education. The last day of the convention centered on the theme "New responsibilities for science teachers." Paul L. Dressel (Michigan State University) delivered the keynote address.

Each of the programs was followed by a series of panel discussions or work-discussion groups, which provided participants with a chance to share ideas related to the theme and the keynote address of the day. These opportunities to discuss implications for science teaching were not the only rewards for the nearly 1300 science educators who attended, from all parts of the nation. They also had ample opportunity to bring themselves up to date through addresses such as "The space satellite" and the "International Geophysical Year," delivered by Jason J. Nassau (Warner-Swasey Observatory, Case Institute of Technology). This address was followed by a series of special demonstrations in the fields of physics, chemistry, biology, and general science. The highlight of the annual banquet was a presentation by Laurence H. Snyder (University of Oklahoma). In his paper on "The rationality of some intuitive foundation stones," Snyder showed how recent developments in genetics and biochemistry lend convincing support to theories that were formerly based on uncannily shrewd intuitive hypotheses.

Popular features of the convention included industrial and educational tours in the Cleveland vicinity, commercial exhibits of scientific supplies and resources, and "Here's how I do it" sessions—exchanges of practical, down-to-earth ideas for teaching science more effectively. A successful new feature was the "Curbstone clinic," which provided an opportunity for conferees to engage in informal group discussions with informed consultants of their choice in more than a score of related fields.

Election of new officers for the coming year was held. Convention members were told of plans that are already under way for the sixth annual NSTA convention, to be held in Denver, Colo., 26–29 Mar. 1958. Donald Decker (Colorado State College of Education) will be the host chairman.

GERTRUDE W. CAVINS
San Jose State College,
San Jose, California

Society Elections

■ Society for Investigative Dermatology: pres., Walter G. Lobitz, Jr., Hanover, N.H.; v. pres., Hermann K. B. Pinkus, Monroe, Mich.; sec.-treas., Herman Beerman, Society of Investigative Dermatology, 255 S. 17 St., Philadelphia 3, Pa.; directors, 1957–62, Eugene M. Farber, San Francisco, Calif., and Albert M. Kligman, Hospital of the University of Pennsylvania, Philadelphia, Pa.

■ National Association of Biology Teachers: pres., John Breukelman, State Teachers College, Emporia, Kans.; past pres., John P. Harrold, Midland High School, Midland, Mich.; pres.-elect, Irene Hollenbeck, Southern Oregon College, Ashland; 1st v. pres, Howard E. Weaver, University of Illinois, Urbana; 2nd v. pres., Frances L. Hall, Columbia University, New York, N.Y.; 3rd v. pres., Robert L. Smith, DeKalb High School, DeKalb, Ill.; sec.-treas. Paul V. Webster, Bryan City Schools, Bryan, O.

■ American Surgical Association: pres., John H. Mulholland, New York University College of Medicine, New York, N.Y.; 1st v. pres., Richard K. Gilchrist; 2nd v. pres., Henry N. Harkins; sec., William A. Altemeier, Christian R. Holmes Hospital, Cincinnati, Ohio; treas., John C. Burch.

■ National Association of Science Writers: pres., Milton Silverman, San Francisco *Chronicle,* San Francisco, Calif.; v. pres., John Troan, Pittsburgh *Press,* Pittsburgh, Pa.; sec.-treas., Pierre C. Fraley, Science Editor, Philadelphia *Bulletin,* Philadelphia, Pa.

Forthcoming Events

August

5–6. Experimental Psychology and Animal Behavior Section of Internatl. Union of Biology, Brussels, Belgium. (H. S. Langfeld, Dept. of Psychology, Princeton Univ., Princeton, N.J.)

5–11. Pan American Cong. of Pediatrics, 5th, Lima, Peru. (C. F. Krumdieck, Washington 914, Lima.)

5–17. Curare and Curare-Like Agents, internatl. symp., Rio de Janeiro, Brazil. (C. Chagas, Instituto de Biofisica, Universidade do Brasil, 458 Avenida Pasteur, Rio de Janeiro.)

6–9. Poultry Science Assoc., annual, Columbia, Mo. (C. B. Ryan, Texas A.&M. College, College Station.)

6–16. World Conf. against A and H Bombs and for Disarmament, 3rd, Tokyo, Japan. (K. Yasui, Tokyo Univ., Tokyo.)

7–9. Industrial Applications of X-Ray Analysis, 6th annual conf., Denver, Colo. (J. P. Blackledge, Metallurgy Div., Denver Research Inst., Univ. of Denver, Denver 10.)

7–9. International Union against the Venereal Diseases and the Treponematoses, 31st general assembly, Stockholm, Sweden. (Secretary General, Institut Alfred Fournier, 25, boulevard Saint-Jacques, Paris 14e, France.)

8–15. International Statistical Inst., 30th, Stockholm, Sweden. (Secretary General, ISI 30th Session, Fack, Stockholm 5.)

8–15. International Union for the Scientific Study of Population, Stockholm, Sweden. (F. Lorimer, c/o American University, Washington 16.)

11–14. Heat Transfer, national conf., University Park, Pa. (G. M. Dusinberre, Pennsylvania State Univ., University Park.)

11–16. Canadian Pharmaceutical Assoc., 50th anniversary convention, Montreal, Quebec, Canada. (A. F. Larose, Faculty of Pharmacy, Univ. of Montreal.)

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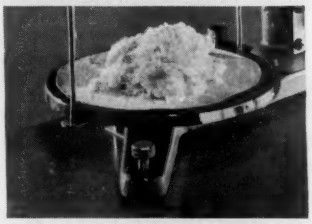

With one of the lowest bulk densities among Eastman Organic solids, regard these five grams of fluff. Familiarize yourself with the look of *N,N-Diethylaminoethylcellulose* (Eastman 7392; 25 g. for $4.60, 100 g. for $15.90). It looms as the standard anion-exchange packing for chromatographic columns set up to resolve proteins.

Despite our many years in cellulose chemistry, and despite our having invented and manufactured oxycellulose for the purification of ACTH by ion exchange, the idea for DEAE-cellulose seems to have entered the heads of some folks at the National Institutes of Health instead of ours (*J.A.C.S.*, *78*, 751). We are not crestfallen, though, for we recognize that our lot is to make and sell Eastman Organic Chemicals and invent only when we can.

A gentleman in Philadelphia named Earl Usdin has been so grateful at being spared the mess of preparing his own DEAE-cellulose that he has shared with us his experience here and in Sweden with a further elaboration of the idea, N,N,N-triethylaminoethylcellulose. This is a quaternary compound, with a charged nitrogen ready to attract anions as soon as the coating of hydroxyls that preserve its electrical neutrality has been removed. With that kind of attractive force in play, the casual bystander would expect to find TEAE-cellulose much more anion-avid than DEAE-cellulose, which depends on the mere general basicity of amine nitrogen. Doctor Usdin, no casual bystander in this area, reports that actually the effective difference between the two is small.

Certain folic acid derivatives that interest him come off the TEAE-cellulose with phosphate developers at pH 6.1, as compared with the rather destructive pH 1 to 2 levels which the older-fashioned, ante-cellulosic ion-exchange resins need to make them let go. He claims that once you have the DEAE-cellulose it's a breeze to convert to TEAE-cellulose. Just reflux with *Bromoethane* (Eastman 114).

We'll give this some time to sink in. Then, if demand should develop for TEAE-cellulose, we might be moved to offer that too. Meanwhile you are welcome to an abstract of the procedures for chromatography with these fluffs. Also to a copy of our catalog of some 3600 organic chemicals we stock, "Eastman Organic Chemicals List No. 40." Write Distillation Products Industries, Eastman Organic Chemicals Department, Rochester 3, N. Y. (Division of Eastman Kodak Company).

Out to 25μ

As the tide of excitement about infrared optics continues to rise, this may be a good time to run up the flag of arsenic-cross-linked selenium and see who salutes. He and we ought to know each other.

Thanks to Fortune's smile, we have been able to afford to let a labful of chemists devote themselves for several years to the proposition that mechanically and optically decent inorganic polymers could be made out of sulfur's lesser known sister, who was named after the moon. Acquaintance has ripened into intimacy. The issue is a kind of glass with refractive index 2.45 or higher. Black as pitch by reflected visible light, it has a transmittance that is optically useful out to a prodigious 25μ, practically long enough to modulate with your favorite TV situation comedy.

This 92% Se - 8% As glass is quite a different animal from arsenic trisulfide, which begins falling off at 9μ. Except for an absorption band at about 12.6μ, most of its transmission loss arises from Fresnel reflection due to the high refractive index, and there are said to be ways of fixing that. The high index, on the other hand, is a blessing when infrared detectors are embedded in the glass in order to boost their geometrical radiation-collecting effectiveness.

Kodak Selenium Glass retains its rigidity to about 70 C and does not crystallize after long exposure to this temperature.

Though the production scale is still modest, we would like to try supplying it in molded shapes to manufacturers determined to outdo us on optical systems employing it. Or in short rods to those who want to beat us even at molding it and have only b-n waiting for such a material to be developed and offered.

Potential competitors at either level and other friends are most cordially invited to submit inquiries about Kodak Selenium Glass *to Eastman Kodak Company, Apparatus and Optical Division, Rochester 4, N. Y.*

Decency in the Temples of Science

Elsie Garvin keeps our researchers from wasting time with research. That is the properly bombastic way to describe the function exercised by Miss Garvin in our own Research Laboratories and by her equally competent sister and brother librarians in all the other great Temples of Science. They counteract the natural instinct of the scientist to rush to his test tubes and prove what had already been proved with crushing force 27 years previously.

But here *we sell the test tubes* or, less figuratively, the photographic materials that are just as representative a tool of research as test tubes used to be.

Yet we find Miss Garvin compiling a *Bibliography on High-Speed Photography* that runs to 35 pages of rather small type and provides easy entrée to a vast mass of knowledge accumulated over the decades about both equipment and techniques for every kind of high speed photography and about its findings in many, many branches of science and engineering—knowledge the duplication of which would consume incalculable miles of nice, fresh Kodak Film.

And what is to be done with Miss Garvin's bibliography? As long as the supply lasts, a free copy is to be sent *at our own expense* to any person wise enough to ask for it before plunging into a project in high speed photography.

Somehow it seems the decent thing to do. Requests should be addressed to Eastman Kodak Company, Professional Sensitized Goods Division, Rochester 4, N. Y.

Prices quoted are subject to change without notice.

Kodak

This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science

11–17. World Federation for Mental Health, 10th annual, Copenhagen, Denmark. (Miss E. M. Thornton, 19 Manchester St., London, W.1, England.)

12–16. Canadian Teachers' Federation, annual, Edmonton, Alberta, Canada. (G. G. Croskery, 444 MacLaren St., Ottawa 4, Ont.)

12–18. Theory of Functions, internatl. colloquium, Helsinki, Finland. (B. Eckmann, Ecole Polytechnique, Federale, Zurich, Switzerland.)

12–25. International Soc. of Soil Mechanics and Foundation Engineering, 4th Conf., London, England. (A. Banister, Institution of Civil Engineers, Great George St., London, S.W.1.)

18–21. American Astronomical Soc., Urbana, Ill. (J. A. Hynek, Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge 38, Mass.)

19–21. National Council of Teachers of Mathematics, Northfield, Minn. (M. H. Ahrendt, NCTM, 1201 16 St., NW, Washington 6.)

19–22. American Veterinary Medical Assoc., annual, Cleveland, Ohio. (J. G. Hardenbergh, AVMA, 600 S. Michigan Ave., Chicago 5, Ill.)

19–23. Clay Conf., 6th natl., Berkeley, Calif. (Dept. of Conferences and Special Activities, Univ. of California Extension, Berkeley 4.)

19–23. Clinical Chemistry, 2nd international European cong., Stockholm, Sweden. (K. Agner, Box 12024, Stockholm 12.)

19–23. Plant Science Seminar, 34th annual, Montreal, Quebec, Canada. (F. L. Mercer, St. Louis College of Pharmacy, St. Louis 10, Mo.)

19–24. Finite Groups, internatl. colloquium, Tübingen, Germany. (H. Wielandt, Faculty of Mathematics and Natural Science, Eberhard-Karls-Universität, Tübingen.)

19–24. High Energy Physics Symp., Oak Ridge, Tenn. (University Relations Div., Oak Ridge Inst. of Nuclear Studies, P.O. Box 117, Oak Ridge.)

19–24. New England Assoc. of Chemistry Teachers, 19th summer conf., Waterville, Maine. (Rev. J. A. Martus, College of the Holy Cross, Worcester 10, Mass.)

19–24. Origin of Life, internatl. symp., Moscow, U.S.S.R. (G. A. Deborin, Inst. of Biochemistry, U.S.S.R. Acad. of Sciences, B. Kaluzskaya 33, Moscow, B.71.)

20–22. Liquid Scintillation Counting Conf., Evanston, Ill. (C. G. Bell, Jr., Technological Inst., Northwestern Univ., Evanston.)

20–23. Western Electronic Convention, annual, San Francisco, Calif. (D. B. Harris, Electron Tube Research, General Electric Microwave Lab., Palo Alto, Calif.)

21–24. Pi Lambda Theta, New York, N.Y. (C. Johnson, Pi Lambda Theta, 307 Portland Bldg., 1129 Vermont Ave., NW, Washington 5.)

22–5. International Scientific Radio Union, 12th general assembly, Boulder, Colo. (K. A. Norton, Boulder Laboratories, National Bur. of Standards, Boulder.)

24–26. International Soc. for Biological Rhythm, 6th conf., Semmering, Austria. (A. Sollberger, Anatomical Department, Karolinska Institutet, Stockholm 60, Sweden.)

25–27. Pacific Division-AAAS, annual, in conjunction with American Inst. of Biological Sciences, Stanford, Calif. (R. C. Miller, California Academy of Sciences, Golden Gate Park, San Francisco, Calif.)

25–28. American Farm Economic Assoc., natl., Asheville, N.C. (L. S. Hardin, Dept. of Agricultural Economics, Purdue Univ., Lafayette, Ind.)

25–29. American Institute of Biological Sciences, annual, Stanford, Calif. (H. T. Cox, AIBS, 2000 P St., NW, Washington 6.)

26–28. Gas Dynamics Symp., 2nd, Evanston, Ill. (A. B. Cambel, Technological Inst., Northwestern Univ., Evanston.)

26–29. Boundary Layer Research, internatl. symp., Freiburg, Breisgau, Germany. (H. Görtler, Mathematisches Institut der Universität, Hebelstrasse 40 Freiburg, Breisgau.)

26–29. Mathematical Assoc. of America, 38th summer, University Park, Pa. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

26–30. American Mathematical Soc., 62nd summer, University Park, Pa. (J. H. Curtiss, AMS, 190 Hope St., Providence 6, R.I.)

26–30. Infrared Spectroscopy Inst., 8th annual, Nashville, Tenn. (N. Fuson, Infrared Spectroscopy Inst., Fisk Univ., Nashville 8.)

26–31. Low Temperature Physics and Chemistry, 5th internatl. conf., Madison, Wis. (J. R. Dillinger, Dept. of Physics, Univ. of Wisconsin, Madison 6.)

27. Society for Industrial and Applied Mathematics, summer, University Park, Pa. (D. L. Thomsen, Jr., 807 Enquirer Bldg., Cincinnati 2, Ohio.)

27–29. American Sociological Soc., annual, Washington, D.C. (Mrs. M. W. Riley, ASS, New York Univ., Washington Sq., New York 3.)

27–30. Biological Photographic Assoc., 27th annual, Rochester, Minn. (S. J. McComb, Section of Photography, Mayo Clinic, Rochester.)

28–30. Gas Chromatography, internatl. symp., East Lansing, Mich. (H. J. Noebels, IGC Symp., Instrument Soc. of America, 313 Sixth Ave., Pittsburgh, Pa.)

28–31. Soil Conservation Soc. of America, annual, Asilomar, Calif. (H. W. Pritchard, 838 Fifth Ave., Des Moines 14, Iowa.)

28–3. Cell Biology, 9th internatl. cong., St. Andrews, Scotland. (H. G. Callan, Dept. of National History, Bell Pettigrew Museum, The University, St. Andrews, Fife.)

29–30. Computers and Data Processing, 4th annual symp., Denver, Colo. (J. M. Cavenah, Denver Research Inst., Univ. of Denver, Denver 10.)

29–30. Econometric Soc., European meeting, Luxemburg, Duchy of Luxemburg. (Econometric Soc., Box 1264, Yale Station, New Haven, Conn.)

29–31. Group Psychotherapy, 2nd internatl. cong., Zurich, Switzerland. (S. Lebovici, 3, Avenue President Wilson, Paris 16e, France.)

(*See issue of 21 June for comprehensive list*)

LETTERS

The editors take no responsibility for the content of the letters published in this section. Anonymous letters will not be considered. Letters intended for publication should be typewritten double-spaced and submitted in duplicate. A letter writer should indicate clearly whether or not his letter is submitted for publication. For additional information, see Science **124**, *249 (1956) and* **125**, *16 (4 Jan. 1957).*

"Clocking" Horse Races

The articles by M. H. Lietzke [*Science* **124**, 178 (1956)] and by George P. Meade [*Science* **124**, 1025 (1956)] deal with measuring athletic performance and, in particular, consistent running records by time-distance measurements.

In my research in the field of racing prepotency of Thoroughbred horses, I have found that racing performance of horses cannot be measured sufficiently accurately by time-distance measurements. Horsemen have long known that no two tracks are equally fast, that no single track is consistently fast from day to day and often from hour to hour, and that trackmasters can and do vary track conditions at will, within certain limits.

Moreover, nearly all time measurements of athletic events are made by manually operated stop watches. I do not believe that there is any fixed way in which timers operate their stop watches. The turnover in personnel is large. In 1955 there were 98 official timers, only 21 of whom had served for as long as 6 years. During the 40-year period covered by the data on stakes races and the longer period covered by the data on track records, the individual timers must have numbered in the thousands. Consequently, it is not likely that there is a universal, systematic method of timing. Time measurements are likely to be inaccurate to at least one interval of measurement (usually 1/5 second, which is equivalent to 10 to 12 feet in horse running races) as a result of human psychological aberrations.

Fractional-second times for Thoroughbred running races for the period 1910–1949 are given by the *American Racing Manual* (Triangle, Chicago, 1950) as follows: (i) Track records through 1949 on all listed tracks (1416 races): 1/5 second, 16.9 percent; 2/5 second, 19.5 percent; 3/5 second, 19.9 percent; 4/5 second, 16.7 percent; even seconds, 27 percent. (ii) One hundred major stakes events (3183 races): 1/5 second, 16.1 percent; 2/5 second, 19.2 percent; 3/5 second, 19.8 percent; 4/5 second, 17.3 percent; even seconds, 27.6 percent.

These data show that "clockers" dislike timing races in the fractional intervals and prefer even seconds. There is a small net change of actual times from

the 2/5 second interval to the 1/5 second interval and, likewise, from the 3/5 second to the 4/5 second interval. There is a considerable net change of actual times from the 1/5 and 4/5 second intervals to the even seconds.

That this marked preference for the even second is peculiar only to "clockers" of horse races and to no one else is improbable.

In view of these extraneous variables, it does not seem possible to establish a definitive time-distance relationship for horse running races.

W. B. Taber, Jr.
Kansas, Illinois

Scientific Poetry

For some years now, in discussing the fact that the impact of science on mankind may well lead to misunderstanding and trouble unless scientists can make their discoveries emotionally apparent to people, I have suggested that we need scientific poetry. Now the contribution made by acknowledged poets is very small (a little from Shelley and Milton, but not a vital body of poetry), and it seems to be increasing only trivially. On the other hand, I feel sure that many scientists are writing verse (I can name three). I would like to suggest that anyone who has any such lines, and who would care to do so, send them to me as a kind of clearinghouse. If enough material arrives, arrangements can be made to mimeograph and circulate it among those who are interested.

I suggest one or two ground rules. The first is that the author give his name, even if the poem is signed with a pseudonym. The second is that poems of epic dimensions be considered a little out of place until means for handling them have developed. The third is, of course, that all classes of poetry, serious and light (even including laboratory limericks), are welcome. My address is Box 2166, Yale Station, New Haven, Conn.

Ernest C. Pollard
Yale University,
New Haven, Connecticut

Satirical Biology

Lovers of spoof biology (and who is not?) rejoiced greatly in a recent article on "Biological clock in the unicorn" [*Science* **125**, 874 (3 May 1957)]. The appearance of a satirical spoof of this kind inevitably raises general questions of widespread interest. Is any form of satire a legitimate style in which to write serious scientific criticism in a reputable journal? If so, does any particular instance meet a sufficiently high standard of plausible falsehood combined with some sharp truth? Are there any rules for this sort of thing?

There can be little real question of propriety because satirical spoofs have an ancient and honorable history. The Royal Society of London published its first spoof, designed to administer a wholesome jolt to the credulous, in the 1840's. David Starr Jordan, ichthyologist and university president, taught the gullible the value of suspended judgment in 1896 with his published account of a "sympsychograph," which enabled the operator to penetrate photographically into the minds of seven men simultaneously. In more recent years, Egerton Y. Davis, M.D., of Caughnawaga, P.Q., better known as William Osler of the Johns Hopkins School of Medicine, delighted to puncture some pomposities of medical literature with those incredibly solemn and vacuous studies on the perineal muscles.

It is a matter of opinion whether the present investigation into the physiology of the unicorn matches L. W. Sharp's immortal monograph on *Eoornis Pterovelox,* published by the Buighleigh Press (of Ithaca?) in 1928, or G. Albrecht's camera-documented account of the Schuss yucca, which was printed in *The Scientific Monthly* for October 1952. There is no doubt, however, that the "Clock in the unicorn" carries the kind of refreshing laughter which dissolves the lush overgrowths and precancerous verbosities of the scientific mind.

Spoofs of all kinds involve certain risks, including the risk of being misunderstood. They extend over a broad spectrum, from inconsequential foolery, through high satire, to downright hoaxes intended to deceive for financial gain. The day seems happily past when a scientific idea can be laughed out of court without testing, in the way that Voltaire ridiculed virtually into oblivion the particulate theory of heredity when it was proposed by de Maupertuis, more than a century before Mendel. We can be sure that the question of the nature of any rhythms which may or may not reside in *Drosophila* eggs, fiddler crabs, or slices of New Jersey potatoes will be answered the more rigorously because of the laughter from that incorrigible pedestrian, common sense.

No one, and least of all scientific truth, stands to suffer harm from the well-tempered spoof. Innocence of harm to truth should be the Paris meter by which the legitimacy of a spoof is judged. Other rules? Brevity and rarity —extreme rarity. To specify more would

be like posting a set of regulations for the appearance of the Loch Ness monster.

If there is any danger inherent in the publication of the recent article, it lies in the faint encouragement given to further investigation of the unicorn itself. The importance of the subject can scarcely be doubted, since it has been known from time immemorial that the animal's horn possess pharmacological properties which combine the attributes of the gonadal steroids, lysergic acid, and the juices of a Mexican toadstool.

GAIRDNER B. MOMENT
Department of Biology,
Goucher College,
Baltimore, Maryland

I have received a number of letters and comments about the unicorn, but Moment is the only person who has come to my attention who was misled into thinking that my article was a "hoax" or a "spoof," to be compared with *Eoornis* and the Schuss yucca. If this had been my intention I would have drawn a sine curve instead of troubling to conduct an actual sampling experiment, conforming to a definite model, and I would have invented references published by "Schmutzig-Verlag" instead of trying to guide the reader to some of the most informative literature bearing on the analysis of time series.

In case other readers were deceived, here is the gist of my thesis: One can attach an animal to an instrument which will record numbers representing the amounts of activity that occurred during each hour of the experiment. One can then take these numbers and submit them to arithmetic manipulations and, perhaps, identify "cycles" in the series of numbers. Now, one may ask, were the cycles necessarily present in the animal or could the methods of analysis have led to similar results without the animal, or with an imaginary animal like the unicorn? To answer this question I tried the experiment, which I described in precise detail, so that anyone can repeat it and see that it is no hoax.

Admittedly, my interpretation of the experimental results was somewhat whimsical (as is the last paragraph of Moment's letter), but I gave references that should satisfy those who prefer heavier reading. There was no intent to try to have anyone "laughed out of court," but rather, as I stated the purpose in the article, "to warn the uninitiated that there is a possibility of being misled in the analysis of complicated time series."

LAMONT C. COLE
Department of Zoology,
Cornell University,
Ithaca, New York

EQUIPMENT NEWS

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■ RELAY-OPERATED VOLTAGE DIVIDER consists of five decades, binary-decimal coded. Models are available with accuracies of ± 0.01 or ± 0.001 percent. Resolution is 1 ohm. Operating time of relays is less than 10 msec. Thermally induced transient effects are less than 0.0005 percent of full scale at rated current of 2 ma. Resistors are hermetically sealed in a metal case. Accessories are available for automatic actuation or read-out. (Julie Research Laboratories, Dept. S411)

■ PRINTED CIRCUIT BOARDS of photosensitive glass withstand a continuous operating temperature of 500°C. Since the etching ratio is 15 times higher than that of conventional glasses, small holes with close center-to-center distances can be produced. The boards are available in thicknesses from 0.05 to 0.235 in. and up to 12 by 18 in. in size. (Corning Glass Works, Dept. S410)

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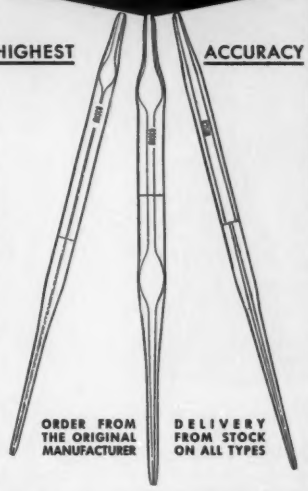

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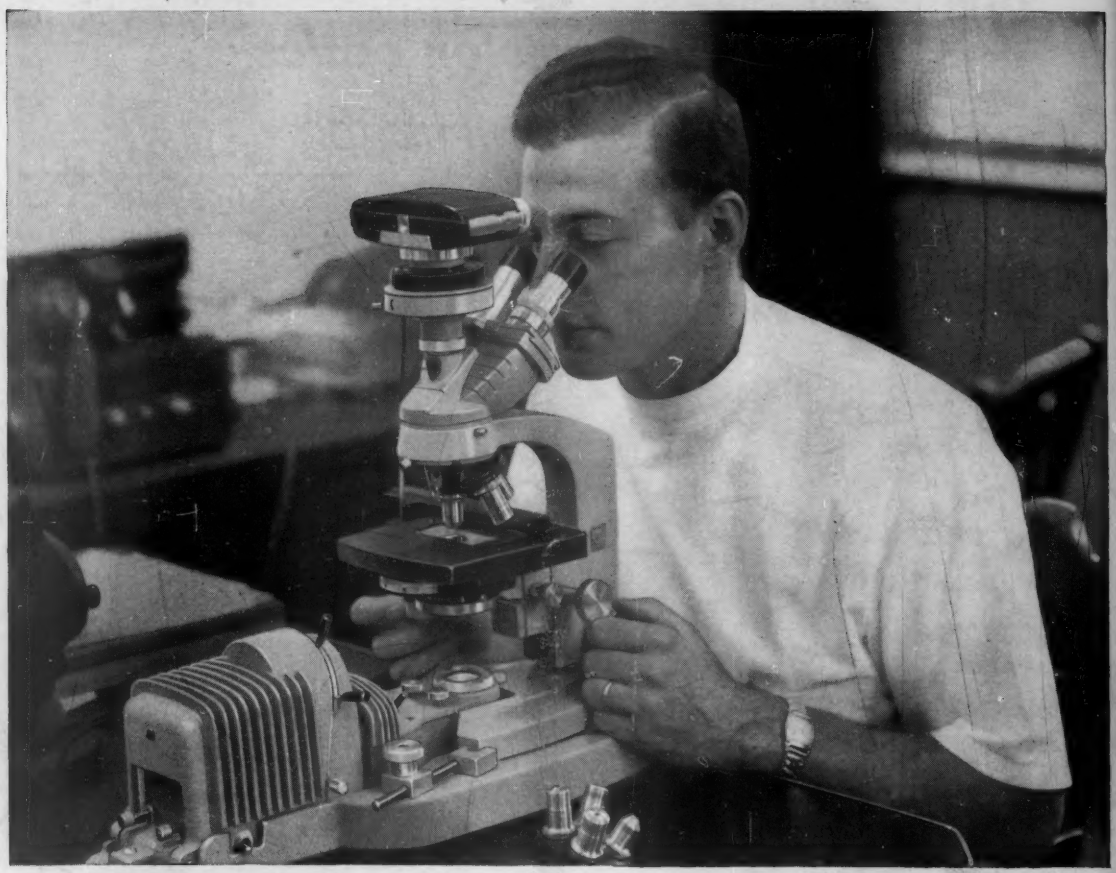

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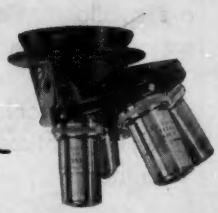

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